

Nemko Korea Co., Ltd.

155 & 159, Osan-Ro, Mohyeon-Myeon, Cheoin-Gu, Yongin-Si, Gyeonggi-Do 449-852 KOREA, REPUBLIC OF

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FCC EVALUATION REPORT FOR CERTIFICATION

Applicant :

Innowireless Co., Ltd.

1-301, Pangyo Seven Venture Valley 2-
danji, 633, Sampyeong-dong, Bundang-gu,
Seongnam-si, Gyeonggi-do, Korea.

(Post code : 463-400)

Attn. : Mr. SeungYeup. Chae

Dates of Issue : August 22, 2013

Test Report No. : NK-13-R-136

Test Site : Nemko Korea Co., Ltd.

FCC ID

2AAM2XCALSOLO

Brand Name

Innowireless

Contact Person

Innowireless Co., Ltd.
1-301, Pangyo Seven Valley 2-danji, 633, Sampyeong-
dong, Bundang-gu, Seongnam-si, Gyeonggi-do,
Telephone No. : +82-31-788-1693

Applied Standard: FCC 47 CFR Part 15.247
Classification: Digital modulation Transmitter
EUT Type: Wireless System Measuring Instrument

The device bearing the brand name and model specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.4-2003, ANSI C63.10-2009. The client should not use it to claim product endorsement by TAF or any government agencies. The test results in the report only apply to the tested sample.

I attest to the accuracy of data and all measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.


Aug. 22, 2013Tested By : Jin-ha Ko
Engineer
Aug 22, 2013Reviewed By : Deokha Ryu
Technical Manager

TABLE OF CONTENTS

1. Scope	4
2. Introduction	5
2.1 Test facility	5
2.2 Accreditation and listing	6
3. Test Conditions & EUT Information	7
3.1 Operation During Test	7
3.1.1 Table of test channels	7
3.1.2 Antenna TX mode information	8
3.2 Support Equipment	8
3.3 Setup Drawing	8
3.4 EUT Information	9
4. Summary of Test Results	10
5. Recommendation / Conclusion	11
6. Antenna Requirements	11
7. Description of Test	12
7.1 Conducted Emissions	12
7.2 Radiated Emissions	13
7.3 6 dB Bandwidth	14
7.4 Maximum Peak Output Power	15
7.5 Peak Power Spectral Density	16
7.6 Conducted Spurious Emissions	17
7.7 Duty Cycle	18
8. Test Data	19
8.1 Conducted Emissions	19
8.2 Radiated Emissions	22
8.3 Duty cycle (Correction factor)	23

8.4 6 dB Modulation Bandwidth	27
8.5 Maximum Peak Conducted Power	34
8.6 Power Spectral Density	42
8.7 Conducted Spurious Emissions	48
8.8 Radiated Spurious Emissions	59
8.9 Radiated Band Edge	65
9. Test Equipment	67
10. Accuracy of Measurement	68
Appendix A: Labelling Requirement	70
Appendix B: Photographs of Test Set-up	71
Appendix C: EUT Photographs	74
Appendix D: Changes of EUT	88

1. SCOPE

Measurement and determination of electromagnetic emissions (EME) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission under FCC part 15.247.

Responsible Party :	Innowireless Co., Ltd.
Contact Person :	Mr. SeungYeup. Chae
Manufacturer :	Innowireless Co., Ltd. 1-301, Pangyo Seven Venture Valley 2-danji, 633, Sampyeong-dong, Bundang-gu, Seongnam-si, Gyeonggi-do, Korea, 463-400

- FCC ID: 2AAM2XCALSOLO
- Model: XCAL-SOLO
- Brand Name: Innowireless
- EUT Type: Wireless System Measuring Instrument
- Classification: Digital modulation Transmitter
- Applied Standard: FCC 47 CFR Part 15.247
- Test Procedure(s): ANSI C63.4-2003, ANSI C63.10 and FCC guidance of Guidance 558074 D01 DTS Meas. Guidance v03r01
- Dates of Test: Jul 16, 2013 ~ Aug 13, 2013
- Place of Tests: Nemko Korea Co., Ltd.

2. INTRODUCTION

2.1 Test facility

The measurement procedure described in American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2003), the American National Standard for Testing Unlicensed Wireless Devices (ANSI C63.10-2009) was used in determining radiated and conducted emissions emanating from **Innowireless Co., Ltd. FCC ID : 2AAM2XCALSOLO**

These measurement tests were conducted at **Nemko Korea Co., Ltd. EMC Laboratory** .

The site address 155 & 159, Osan-Ro, Mohyeon-Myeon, Cheoin-Gu, Yongin-Si, Gyeonggi-Do 449-852 KOREA, REPUBLIC OF.

The area of Nemko Korea Corporation Ltd. EMC Test Site is located in a mountain area at 80 km (48 miles) southeast and Incheon International Airport (Incheon Airport), 30 km (18miles) south-southeast from central Seoul.

It is located in the valley surrounded by mountains in all directions where ambient radio signal conditions are quiet and a favorable area to measure the radio frequency interference on open field test site for the computing and ISM devices manufactures.








The detailed description of the measurement facility was found to be in compliance with the requirements of §2.948 according to ANSI C63.4-2003.



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Fig. 1. The map above shows the Seoul in Korea vicinity area.
The map also shows Nemko Korea Corporation Ltd. EMC Lab. and Incheon Airport.

2.2 Accreditation and listing

Accreditation type		Accreditation number
	FCC part 15/18 Filing site	Registration No. 97992
	CAB Accreditation for DOC	Designation No. KR0026
	KOLAS Accredited Lab. (Korea Laboratory Accreditation Scheme)	Registration No. 155
	Canada IC Registered site	Site No. 2040E
	VCCI registration site(RE/CE/Telecom CE)	Member No. 2118
	EMC CBTL	-
	KCC(RRL)Designated Lab.	Registration No. KR0026
	SASO registered Lab and Certification Body	Registration No. 2008-15

3. TEST CONDITIONS & EUT INFORMATION

3.1 Operation During Test

The EUT is the SISO transceiver supporting the 802.11b/g/n mode.

During the test, the EUT was connected to laptop PC & Cellular phone and then a test program was executed to operate EUT continuously. The operating voltages of EUT were 5 Vdc supplied from a USB port on Laptop PC, 3.8 Vdc supplied from internal rechargeable battery. The 5 Vdc operating mode was decided as the worst case through a pre-scan method. The EUT was tested at the lowest channel, middle channel and the highest channel with the maximum output power in accordance with the manufacturer's specifications. The worst data were recorded in the report.

The EUT was programmed with the following output power setting that was used during testing:

Test frequency		2412 MHz	2437 MHz	2462 MHz
802.11b	Power Level	45	45	45
802.11g	Power Level	65	65	65
802.11n	Power Level	65	65	65

3.1.1 Table of test channels

Test Items	Mode	Data rate (Mbps)	Test Channel (CH)
Conducted Emissions	802.11n	MCS0	6
Radiated Emissions	802.11n	MCS0	6
6 dB Bandwidth	802.11b	11	1/6/11
	802.11g	6	1/6/11
	802.11n	MCS0	1/6/11
Peak Output Power	802.11b	1 Mbps ~ 11 Mbps	1/6/11
	802.11g	6 Mbps ~ 54 Mbps	1/6/11
	802.11n	MCS0 ~ MCS7	1/6/11
Peak Power Spectral Density	802.11b	11	1/6/11
	802.11g	6	1/6/11
	802.11n	MCS0	1/6/11
Conducted Spurious Emission	802.11b	11	1/6/11
	802.11g	6	1/6/11
	802.11n	MCS0	1/6/11
Radiated Spurious Emission, Band edge Emission	802.11b	1	1/6/11
	802.11g	6	1/6/11
	802.11n	MCS0	1/6/11

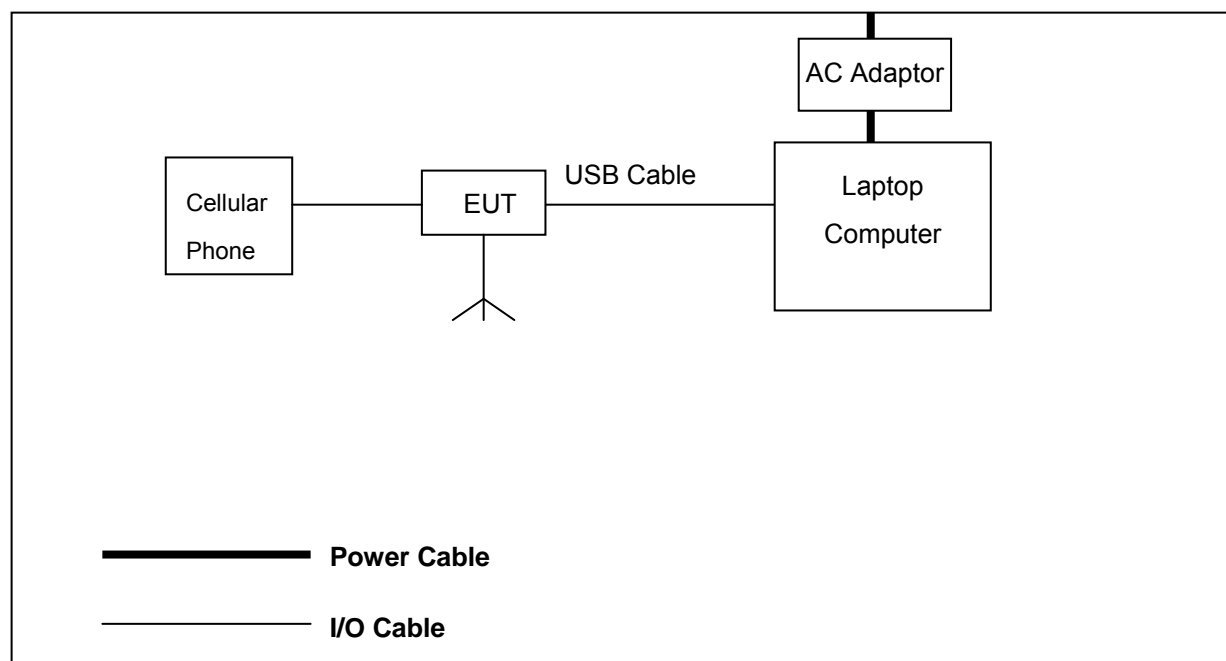
3.1.2 Antenna TX mode information:

Frequency band	Mode	Antenna TX mode	Support MIMO
2.4 GHz	802.11b,g,n	<input checked="" type="checkbox"/> 1TX, <input type="checkbox"/> 2TX	<input type="checkbox"/> Yes, <input checked="" type="checkbox"/> No

3.2 Support Equipment

EUT	Innowireless Co., Ltd. Model: XCAL-SOLO 0.25 m Shielded Mini USB cable 0.1 m Shielded Stereo jack 0.5 m Removable USB cable	FCC ID: 2AAM2XCALSOLO S/N: N/A
Laptop Computer	Samsung Electronics Co., Ltd. Model : NT-R55	FCC DOC S/N : 408L93AP400115W
AC/DC Adapter	Chicony Power Technology Co., Ltd. Model : AD-9019S 1.5 m unshielded power cable	FCC DOC S/N : CNBA4400215ADON81BT01V8
Cellular Phone	Samsung Electronics Co., Ltd. Model : SHW-M250S FCC ID : A3LSHWM250S	S/N: R1AB574829

3.3 Setup Drawing



3.4 EUT Information

The EUT is the **Innowireless Wireless System Measuring Instrument FCC ID: 2AAM2XCALSOLO.**

Specifications:

Category	Wireless System Measuring Instrument
Model Name	XCAL-SOLO
Brand Name	Innowireless
Frequency of Operation	2412 MHz ~ 2462 MHz
Maximum Peak Conducted Output Power	802.11b : 5.85 dBm 802.11g : 12.63 dBm 802.11n : 12.51 dBm
Channels	802.11b,g,n(20 MHz): 11 CH
Antenna Gain (peak)	2.4 dBi
Antenna Setup	1TX / 1RX
Modulations	DSSS(BPSK,QPSK,CCK) for 802.11b OFDM(BPSK,QPSK,16QAM,64QAM) for 802.11g,n
Temperature Range	-5 °C ~ +50 °C
Voltage	3.8 Vdc (Rechargeable battery), 5.0 Vdc (External USB)
Dimensions (H x W x D)	64 mm x 110 mm x 11 mm
Weight	100 g (Including rechargeable battery)
Remarks	-

4. SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specification:

Name of Test	FCC Paragraph No.	Result	Remark
Conducted Emission	15.207	Complies	
Radiated Emission	15.209	Complies	
6 dB Bandwidth	15.247(a)(2)	Complies	
Peak Power Output	15.247(b)(3)	Complies	
Power Spectral Density	15.247(e)	Complies	
Conducted Spurious Emission	15.247(d)	Complies	
Radiated Spurious Emission	15.247(d)	Complies	
Maximum Permissible Exposure	1.1307(b)	Complies	

5. RECOMMENDATION/CONCLUSION

The data collected shows that the **Innowireless Wireless System Measuring Instrument FCC ID: 2AAM2XCALSOLO** is in compliance with Part 15.247 of the FCC rule.

6. ANTENNA REQUIREMENTS

§15.203 of the FCC Rules part 15 Subpart C

: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

The antenna of the **Innowireless Wireless System Measuring Instrument FCC ID: 2AAM2XCALSOLO** is **permanently attached** and there are no provisions for connection to an. It complies with the requirement of §15.203.

7. DESCRIPTION OF TESTS

7.1 Conducted Emissions

The Line conducted emission test facility is located inside a 4 x 7 x 2.5 meter shielded enclosure. It is manufactured by EM engineering. The shielding effectiveness of the shielded room is in accordance with MIL-STD-285 or NSA 65-6. A 1 m x 1.5 m wooden table 0.8 m height is placed 0.4 m away from the vertical wall and 1.5 m away from the side of wall of the shielded room Rohde & Schwarz (ESH3-Z5) and (ESH2-Z5) of the 50 ohm/50 μ H Line Impedance Stabilization Network (LISN) are bonded to the shielded room. The EUT is powered from the Rohde & Schwarz LISN (ESH3-Z5) and the support equipment is powered from the Rohde & Schwarz LISN (ESH2-Z5). Power to the LISNs are filtered by high-current high insertion loss Power line filters. The purpose of filter is to attenuate ambient signal interference and this filter is also bonded to shielded enclosure. All electrical cables are shielded by tinned copper zipper tubing with inner diameter of 1 / 2 ”.

If DC power device, power will be derived from the source power supply it normally will be powered from and this supply lines will be connected to the LISNs, All interconnecting cables more than 1 meter were shortened by non inductive bundling (serpentine fashion) to a 1 meter length.

Sufficient time for EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the spectrum analyzer to determine the frequency producing the maximum EME from the EUT.

The spectrum was scanned from 150 kHz to 30 MHz with 200 msec sweep time.

The frequency producing the maximum level was re-examined using the EMI test receiver.

(Rohde & Schwarz ESCS30). The detector functions were set to CISPR quasi-peak mode & average mode. The bandwidth of receiver was set to 9 kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each EME emission.

Each emission was maximized by; switching power lines; varying the mode of operation or resolution; clock or data exchange speed; scrolling H pattern to the EUT and of support equipment, and powering the monitor from the floor mounted outlet box and computer aux AC outlet, if applicable; whichever determined the worst case emission.

Each EME reported was calibrated using the R&S signal generator.

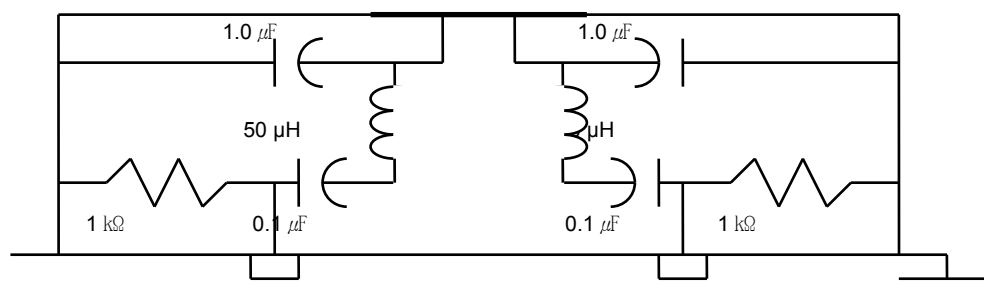


Fig. 2. LISN Schematic Diagram

7.2 Radiated Emissions

The measurement was performed at the test site that is specified in accordance with ANSI C63.4-2003 and ANCI C63.10-2009.

The spurious emission was scanned from 9 kHz to 30 MHz using Loop Antenna(Rohde&Schwarz, HFH2-Z2) and 30 to 1000 MHz using Trilog broadband test antenna(Schwarzbeck, VULB 9163). Above 1 GHz, Horn antenna (Schwarzbeck BBHA 9120D: up to 18 GHz, Q-par Angus QSH20S20 : 18 to 26.5 GHz, QSH22K20: up to 40 GHz) was used.

The test equipment was placed on turntable with 0.8 m above ground. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The EUT, cable, wire arrangement and mode of operation that has the highest amplitude relative to the limit was selected. Then, the turn table was rotated from 0° to 360° and an antenna mast was moved from 1 m to 4 m height to maximize the suspected highest amplitude signal. The final maximized level was recorded.

At frequencies below 1000 MHz, measurements performed using the CISPR quasi-peak detection.

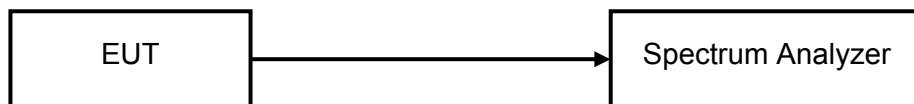
At frequencies above 1000 MHz, measurements performed using the peak and average measurement procedures described in KDB “558074D01 DTS Meas Guidance v03r01” in section 12.2.4 and 12.2.5.1. Peak emission levels were measured by setting the analyzer RBW = 1 MHz, VBW = 3 MHz, Detector = Peak, Trace mode = max hold. Average emission levels were measured by setting the analyzer RBW = 1 MHz, VBW = 3 MHz, Detector = RMS, Trace averaging in power averaging (RMS) mode over a minimum of 100 traces, If continuous transmission of the EUT couldn't be achieved and duty cycle was constant, a correction factor ($10 \log (1 / x)$) was added to the measurement result.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	24000/F(kHz)	30
1.705–30.0	30	30
30–88	100	3
88–216	150	3
216–960	200	3
Above 960	500	3

Radiated Emissions Limits per 47 CFR 15.209(a)

7.3 6 dB Bandwidth

Test Setup



Test Procedure

EUTs 6 dB bandwidth is measured at low, middle, high channels with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level.

The spectrum analyzer setting is as follows.

RBW = 100 kHz

VBW \geq 3 x RBW

Detector = Peak

Trace mode = max hold

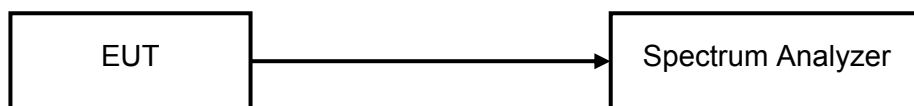
Sweep = auto couple

Allow the trace to stabilize.

The bandwidth measurement function on the spectrum analyzer is used to measure the 6 dB bandwidth.

7.4 Maximum Peak Output Power

Test Setup



Test Procedure

EUTs Maximum Peak Conducted Output Power is measured at low, middle, high channels with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level.

The spectrum analyzer setting is as follows.

RBW = 1 MHz

VBW $\geq 3 \times$ RBW

Span $\geq 1.5 \times$ DTS bandwidth

Detector = peak

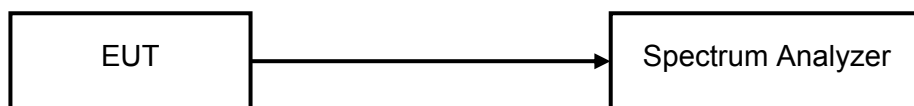
Sweep time = auto couple

Allow the trace to stabilize.

The band power measurement function on the spectrum analyzer is used to measure the Maximum peak conducted output power.

7.5 Peak Power Spectral Density

Test Setup



Test Procedure

EUTs Peak Power Spectral Density is measured at low, middle, high channels with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level.

The spectrum analyzer setting is as follows.

Center frequency = DTS channel center frequency

Span = 1.5 times the DTS channel bandwidth

RBW to : $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$

VBW $\geq 3 \times \text{RBW}$

Detector = peak

Sweep time = auto couple

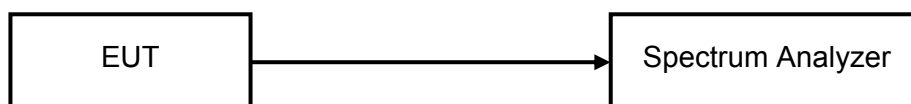
Trace mode = max hold

Allow the trace to stabilize.

The peak search function on the spectrum analyzer is used to determine the maximum amplitude level within the fundamental DTS bandwidth.

7.6 Conducted Spurious Emissions

Test Setup



Test Procedure

EUTs Conducted spurious emissions are measured at low, middle, high channels with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level.

The spectrum analyzer setting is as follows.

1) Reference Level

RBW = 100 kHz

VBW \geq 3 x RBW

Span = 1.5 times the DTS channel bandwidth

Detector = peak

Sweep time = auto couple

Trace mode = max hold

Allow the trace to stabilize.

The peak search function on the spectrum analyzer is used to determine the maximum PSD level.

2) Emission level measurement

RBW = 100 kHz

VBW \geq 3 x RBW

Set the center frequency and span to encompass frequency range to be measured

Ensure that the number of measurement points \geq span / RBW

Detector = peak

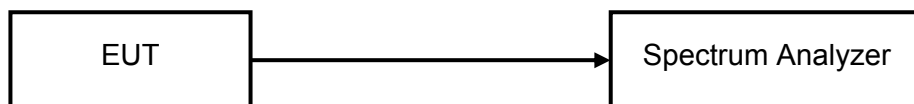
Sweep time = auto couple

Allow the trace to stabilize.

The amplitude of all unwanted emissions outside of the authorized frequency band is confirmed that it is attenuated by at least the minimum requirements specified.

7.7 Duty Cycle

Test Setup



Test Procedure

EUTs duty cycle are measured at middle channel with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level. The spectrum analyzer setting is as follows.

Center frequency = Center frequency of the transmission

Span = zero

RBW = 8 MHz

VBW = 8 MHz

Detector = peak

Sweep time = auto

Trace mode = view

The marker function on the spectrum analyzer is used to determine the duty cycle.

8. TEST DATA

8.1 Conducted Emissions

FCC §15.207

2.4 GHz band

Frequency (MHz)	Level(dBµV)		*)Factor (dB)	**) Line	Limit(dBµV)		Margin(dB)	
	Q-Peak	Average			Q-Peak	Average	Q-Peak	Average
0.17	61.8	41.7	0.2	N	65.0	55.0	3.2	13.3
0.24	53.0	35.1	0.2	N	62.1	52.1	9.1	17.0
0.29	45.9	26.7	0.2	N	60.5	50.5	14.6	23.8
0.36	39.1	20.0	0.2	N	58.7	48.7	19.6	28.7
0.49	37.4	22.2	0.2	N	56.2	46.2	18.8	24.0
3.36	34.1	20.5	0.2	L	56.0	46.0	21.9	25.5

Line Conducted Emissions Tabulated Data

Note(s):

1. Measurements using CISPR quasi-peak mode & average mode.
2. All modes of operation were investigated and the worst -case emission are reported. See attached Plots.
3. *) Factor = LISN + Cable Loss
4. **) LINE : L = Line , N = Neutral
5. The limit is on the FCC Part section 15.207(a).

PLOTS OF EMISSIONS

● **Conducted Emission at the Mains port (Line)**

NEMKO KOREA (NK-13-R-136)

25 Jul 2013 19:34

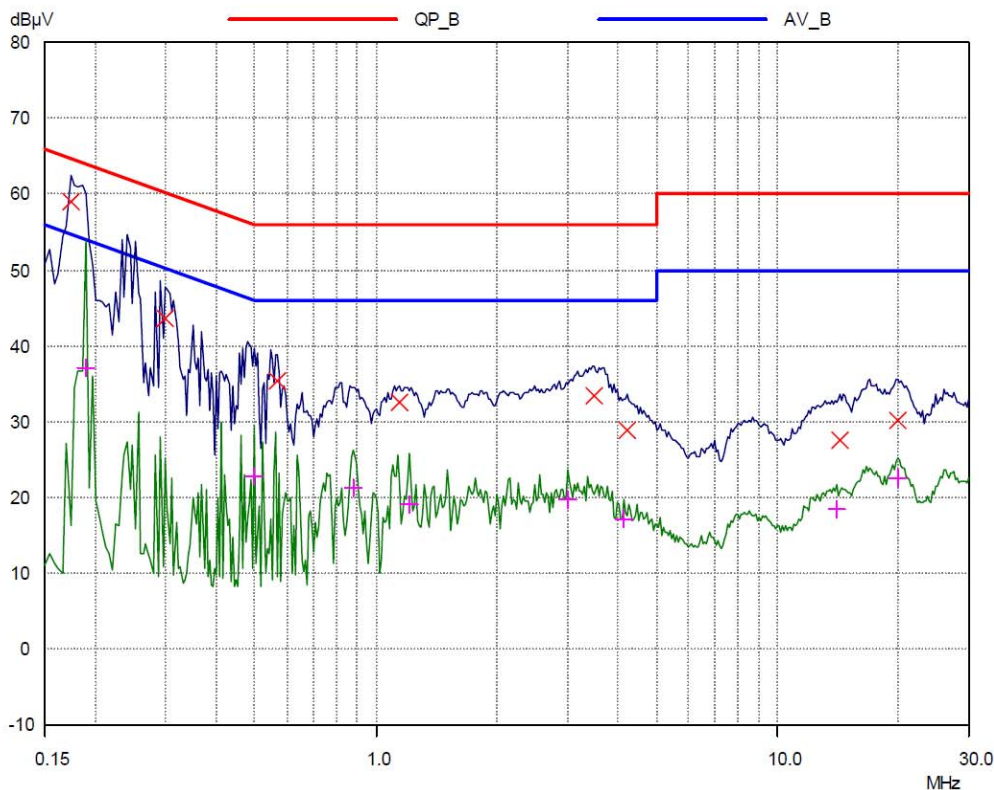
Conducted Emissions

EUT: Wireless System Measuring Instrument
 Manuf: Innwireless
 Op Cond: a.c. 120 V, 60 Hz
 Operator: Jinha. KO
 Test Spec: FCC Part 15.207
 Comment: MODEL : XCAL-SOLO
 LINE : L1

Scan Settings (1 Range)				Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150kHz	30MHz	3.9063kHz	9kHz	PK+AV	20msec	20 dB	OFF	60dB

Transducer	No.	Start	Stop	Name
	1	150kHz	30MHz	ESH3_Z5_Line

Final Measurement: Detectors: X QP / + AV
 Meas Time: 1sec
 Subranges: 8
 Acc Margin: 30 dB



PLOTS OF EMISSIONS

● **Conducted Emission at the Mains port (Neutral)**

NEMKO KOREA (NK-13-R-136)

25 Jul 2013 19:25

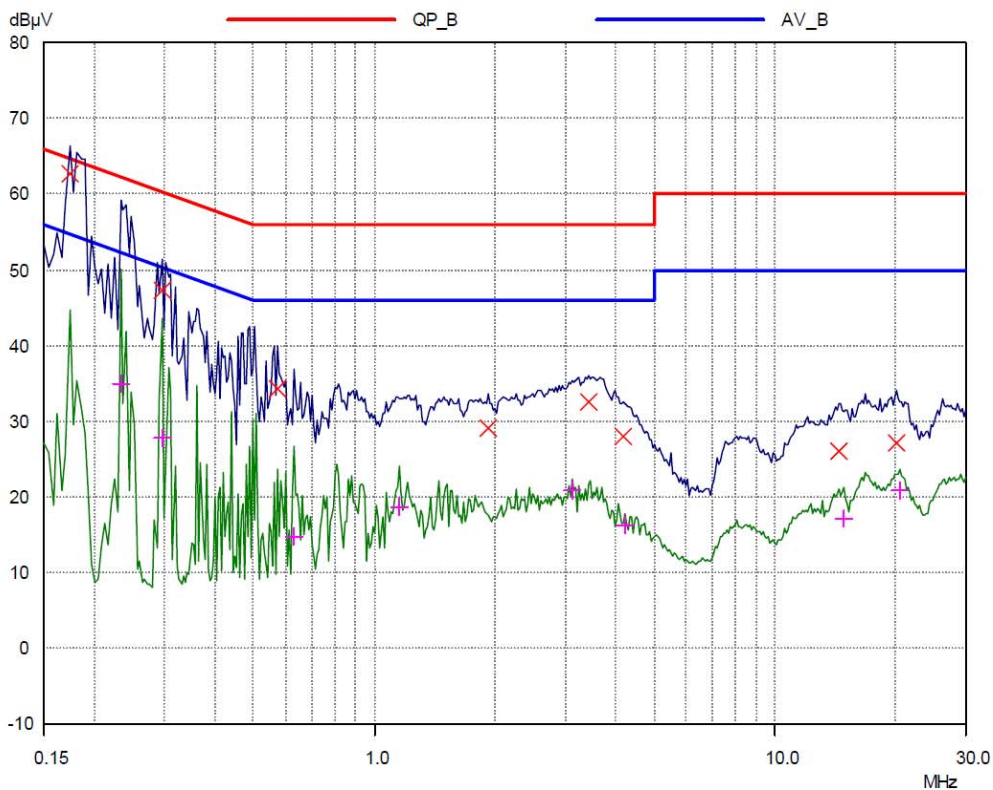
Conducted Emissions

EUT: Wireless System Measuring Instrument
 Manuf: Innwireless
 Op Cond: a.c. 120 V, 60 Hz
 Operator: Jinha. KO
 Test Spec: FCC Part 15.207
 Comment: MODEL : XCAL SOLO
 LINE : Neutral

Scan Settings		(1 Range)			Receiver Settings			
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150kHz	30MHz	3.9063kHz	9kHz	PK+AV	20msec	20 dB	OFF	60dB

Transducer	No.	Start	Stop	Name
	1	150kHz	30MHz	ESH3_Z5_Neutral

Final Measurement: Detectors: X QP / + AV
 Meas Time: 1sec
 Subranges: 8
 Acc Margin: 30 dB



TEST DATA

8.2 Radiated Emissions

FCC §15.209

2.4 GHz band

Frequency (MHz)	Reading (dBµV/m)	Pol* (H/V)	Antenna Heights (cm)	Turntable Angles (°)	AF+CL+Amp (dB)**	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
78.00	54.09	H	320	101	-24.4	29.7	40.0	10.3
286.00	53.89	H	131	282	-22.5	31.4	46.0	14.6
364.00	53.01	H	138	258	-20.5	32.5	46.0	13.5
415.99	50.81	H	100	262	-17.3	33.5	46.0	12.5
624.00	45.16	H	303	231	-11.6	33.6	46.0	12.4

Radiated Measurements at 3meters

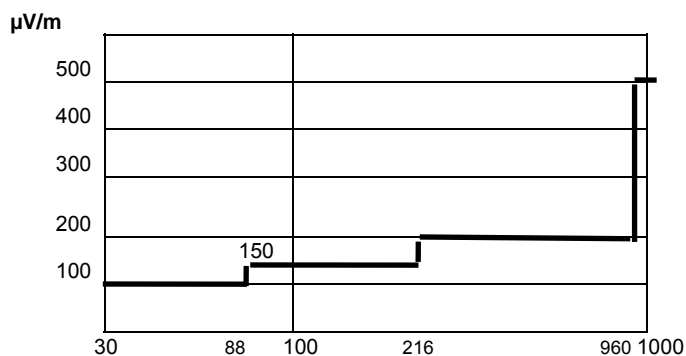


Fig. 3. Limits at 3 meters

Note(s):

1. All modes were measured and the worst-case emission was reported.
 2. The radiated limits are shown on Figure 3.
- Above 1 GHz the limit is 500 µV/m.

3. *Pol. H = Horizontal, V = Vertical
4. **AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.
5. Measurements using CISPR quasi-peak mode.
6. The radiated emissions testing were made by rotating EUT through three orthogonal axes and rotating the receive antenna with horizontal, Vertical polarization. The worst data was recorded.
7. The limit is on the FCC Part section 15.209(a).

TEST DATA

8.3 Duty cycle Correction factor (DCF)

FCC KDB 558074 D01 DTS Meas Guidance v03r01 Clause 6

Test Mode : Set to Lowest channel

802.11b mode

Data rate (Mbps)	On-time (ms)	On+Off-time (ms)	Duty* (%)	DCF** (dB)
1	8.41	8.46	99.41	0.03

802.11g mode

Data rate (Mbps)	On-time (ms)	On+Off-time (ms)	Duty* (%)	DCF** (dB)
6	1.4	1.44	97.22	0.12

802.11n mode

Data rate (Mbps)	On-time (ms)	On+Off-time (ms)	Duty* (%)	DCF** (dB)
MCS0	1.31	1.35	97.04	0.13

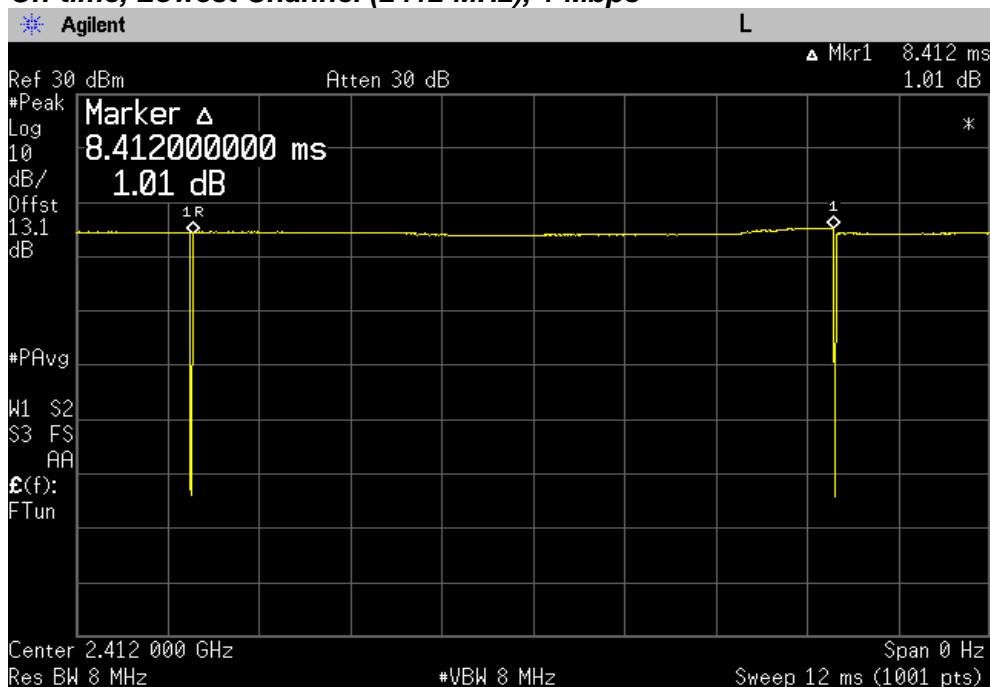
Note(s) :

1. *Duty (%) = (On-time/On+Off-time) x 100 %
2. **DCF (Duty Cycle Correction Factor) = $10 \log (1/x)$, $x = \text{On-time} / (\text{On+Off-time})$

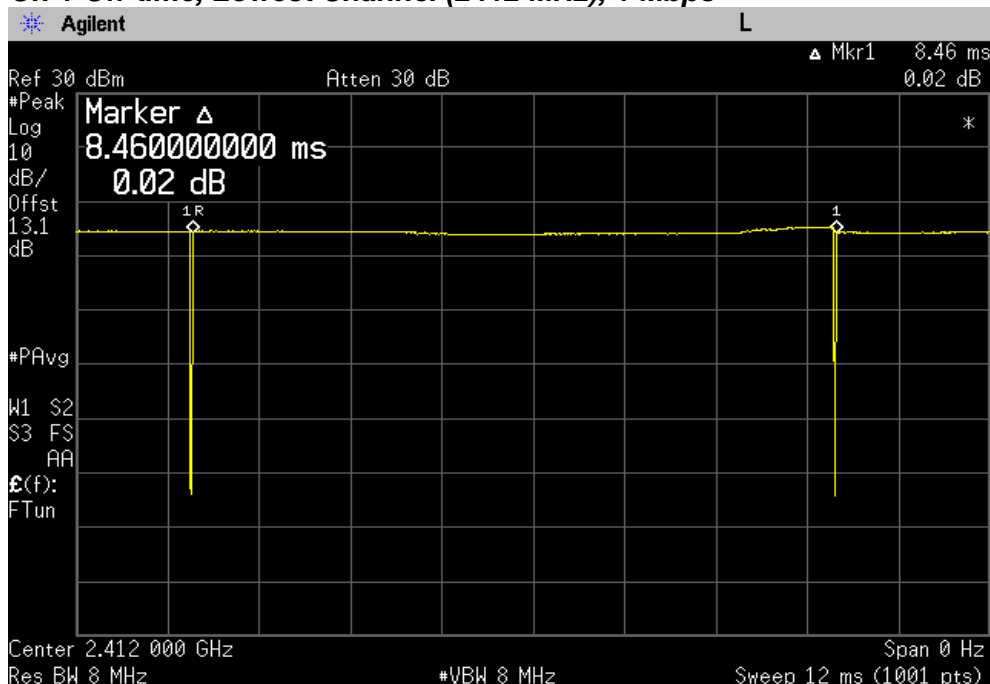
PLOTS OF EMISSIONS

Duty cycle of 802.11b mode

On-time, Lowest Channel (2412 MHz), 1 Mbps



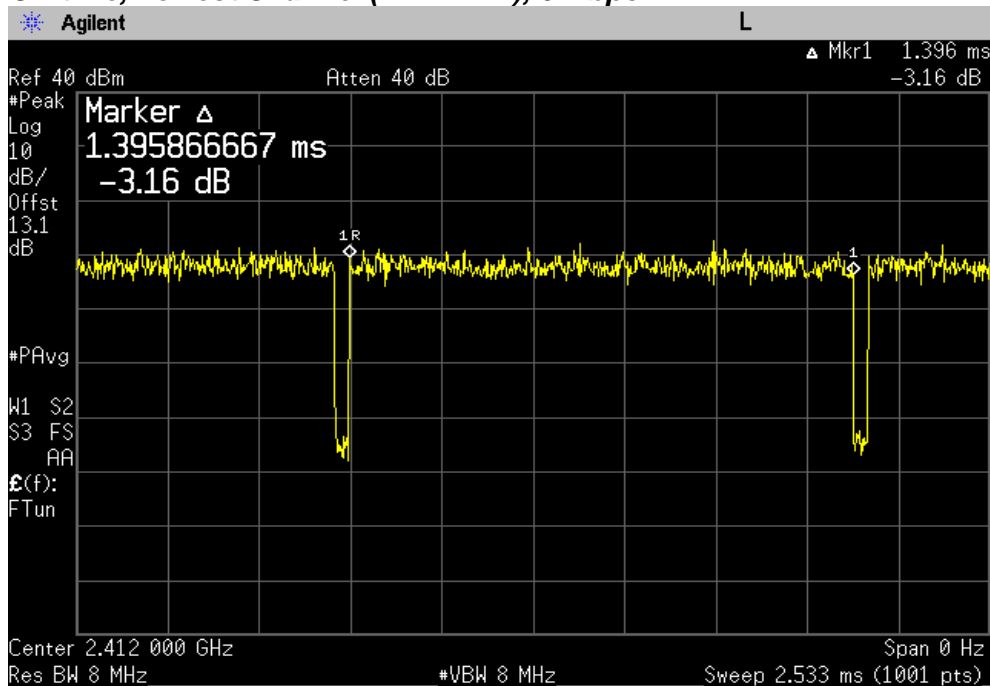
On + Off-time, Lowest Channel (2412 MHz), 1 Mbps



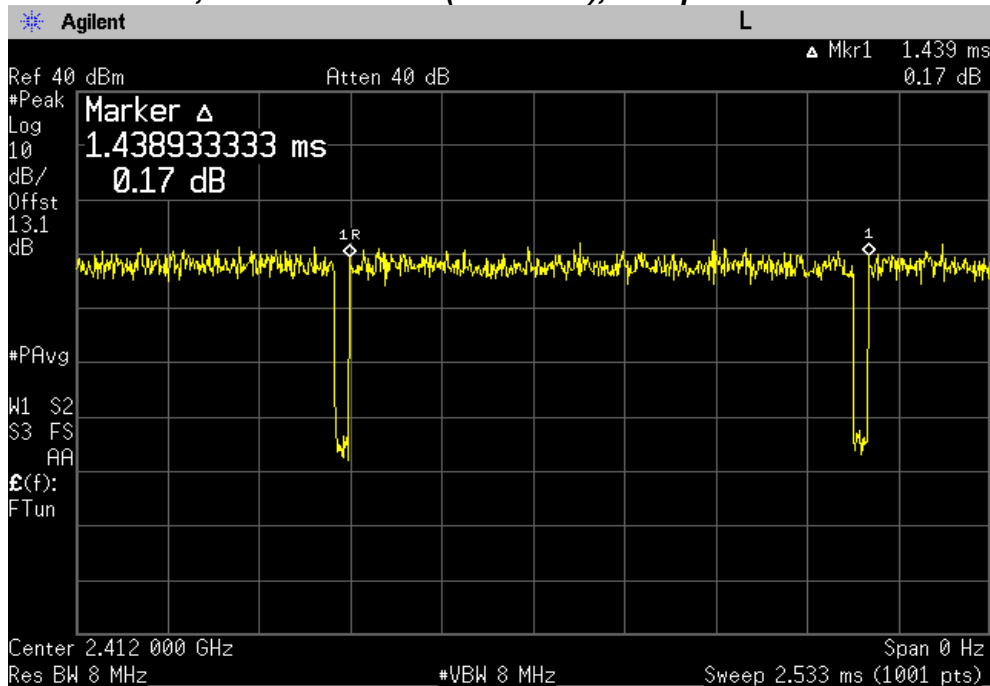
PLOTS OF EMISSIONS

Duty cycle of 802.11g mode

On-time, Lowest Channel (2412 MHz), 6 Mbps



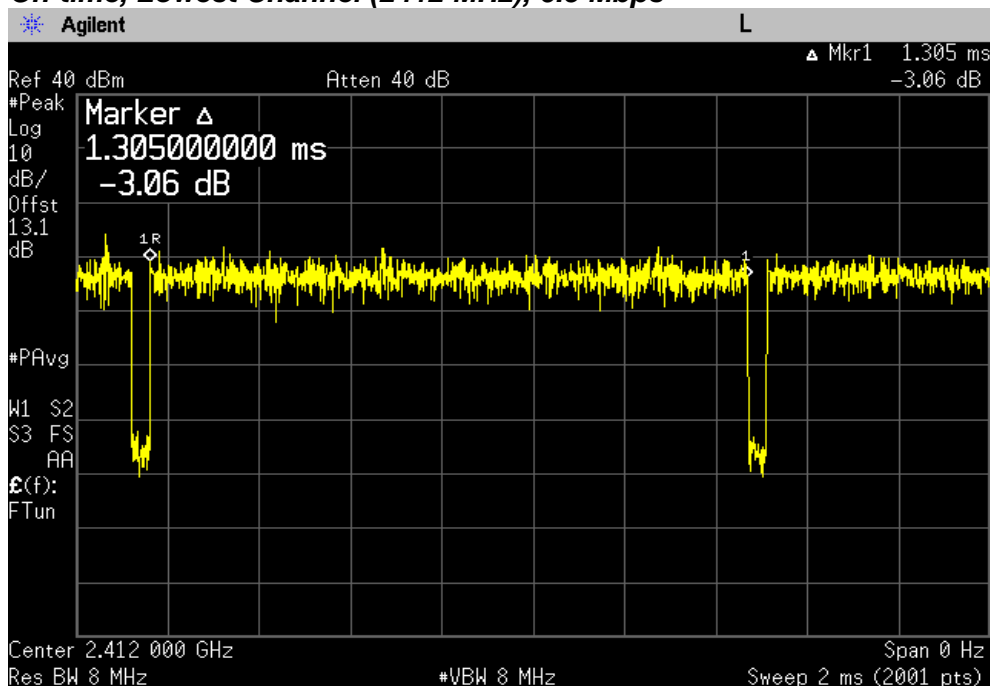
On + Off-time, Lowest Channel (2412 MHz), 6 Mbps



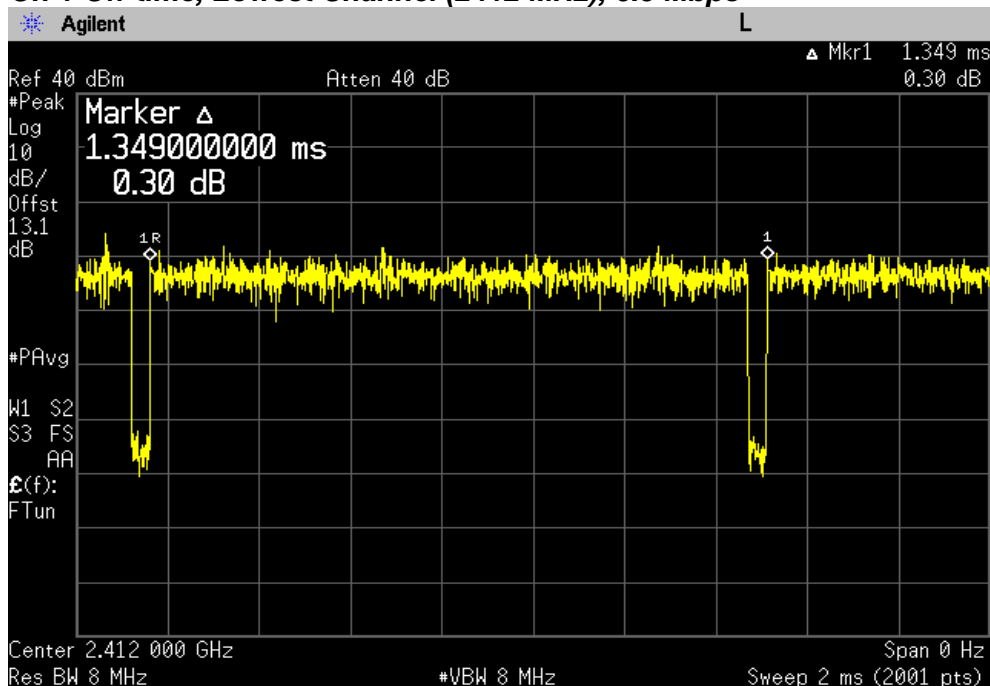
PLOTS OF EMISSIONS

Duty cycle of 802.11n HT20 mode

On-time, Lowest Channel (2412 MHz), 6.5 Mbps



On + Off-time, Lowest Channel (2412 MHz), 6.5 Mbps



TEST DATA

8.4 6 dB Modulated Bandwidth

FCC §15.247(a)(2)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

802.11b mode

Channel	Frequency(MHz)	Result(MHz)	Limit (MHz)
Low	2412	8.11	0.5
Middle	2437	8.28	0.5
High	2462	8.07	0.5

802.11g mode

Channel	Frequency(MHz)	Result(MHz)	Limit (MHz)
Low	2412	15.14	0.5
Middle	2437	15.32	0.5
High	2462	15.14	0.5

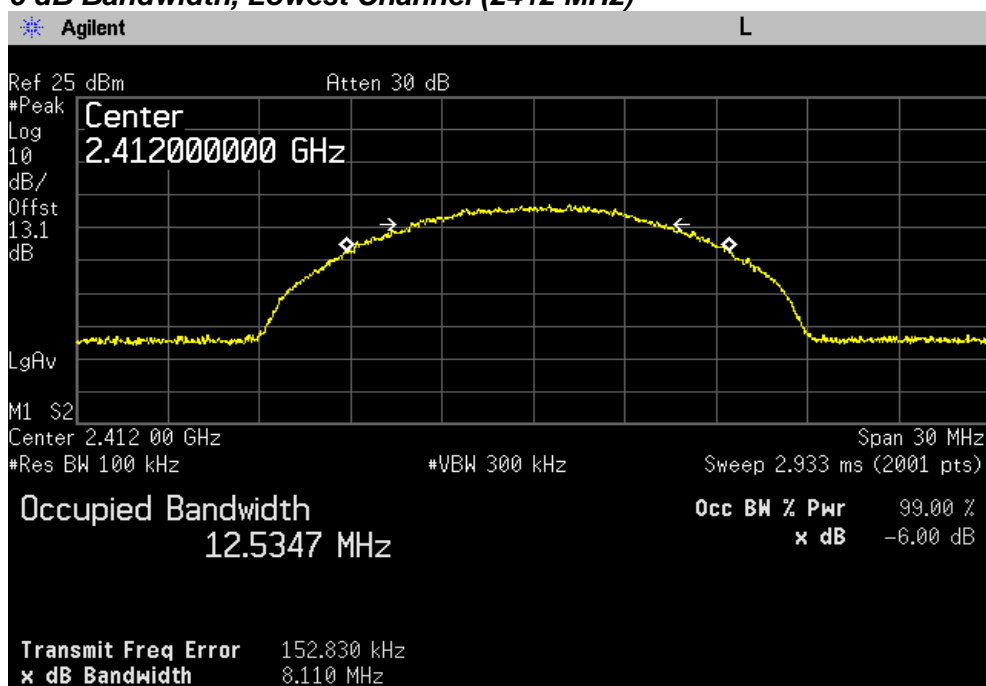
802.11n mode

Channel	Frequency(MHz)	Result(MHz)	Limit (MHz)
Low	2412	15.13	0.5
Middle	2437	15.13	0.5
High	2462	15.13	0.5

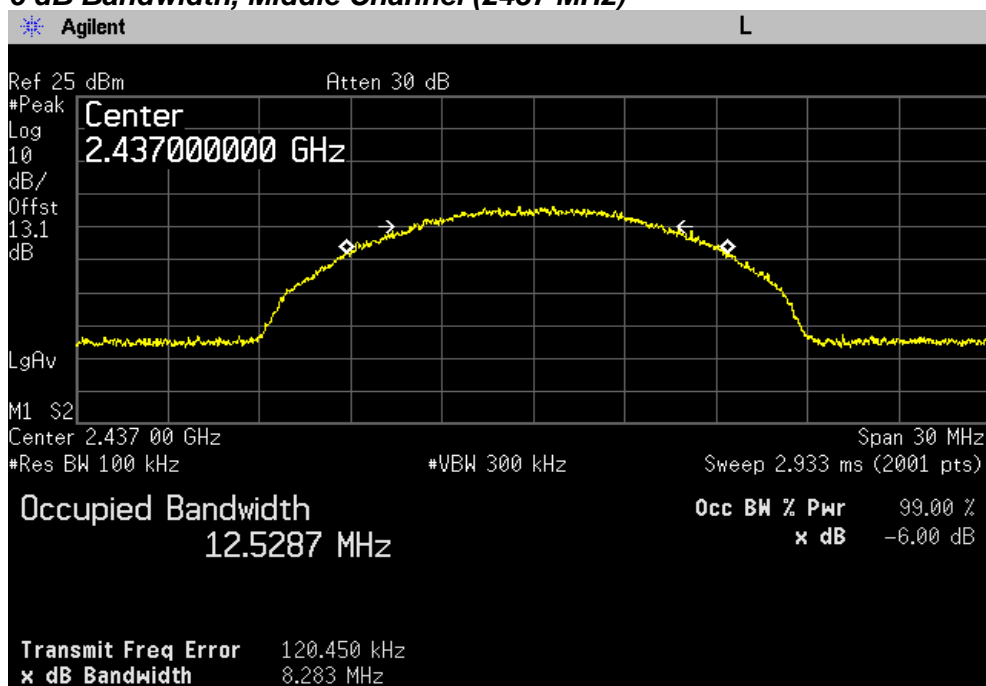
PLOTS OF EMISSIONS

802.11b mode

6 dB Bandwidth, Lowest Channel (2412 MHz)

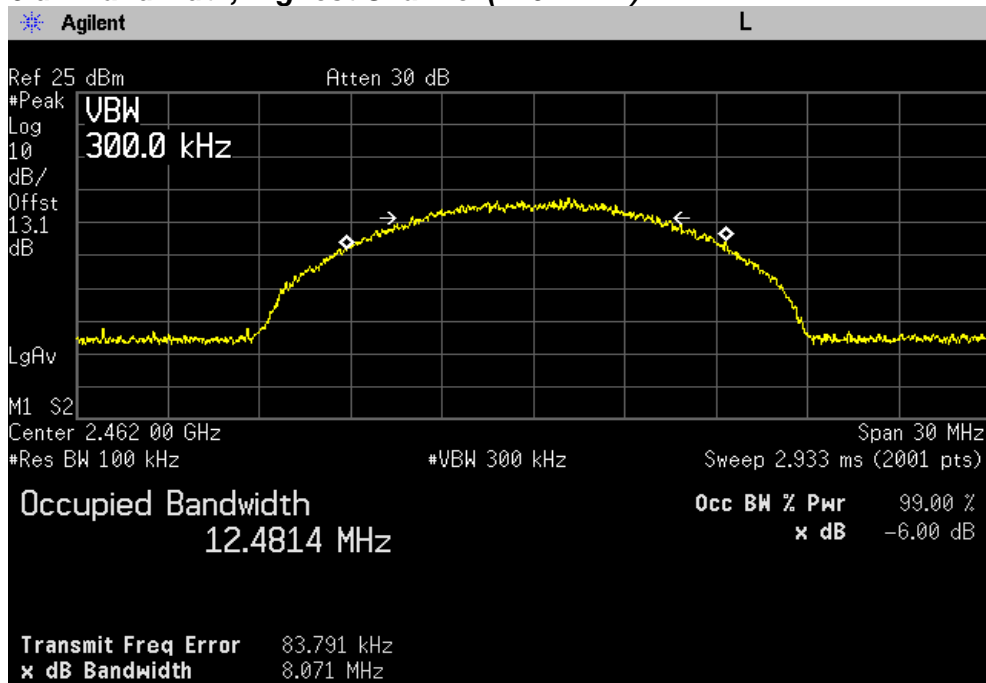


6 dB Bandwidth, Middle Channel (2437 MHz)



PLOTS OF EMISSIONS

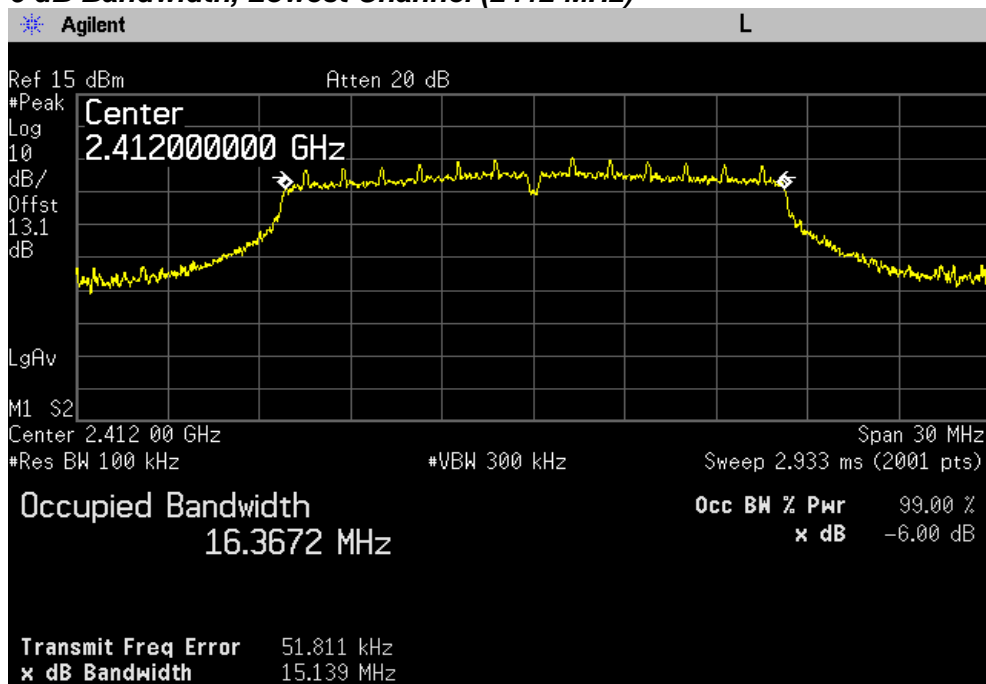
6 dB Bandwidth, Highest Channel (2462 MHz)



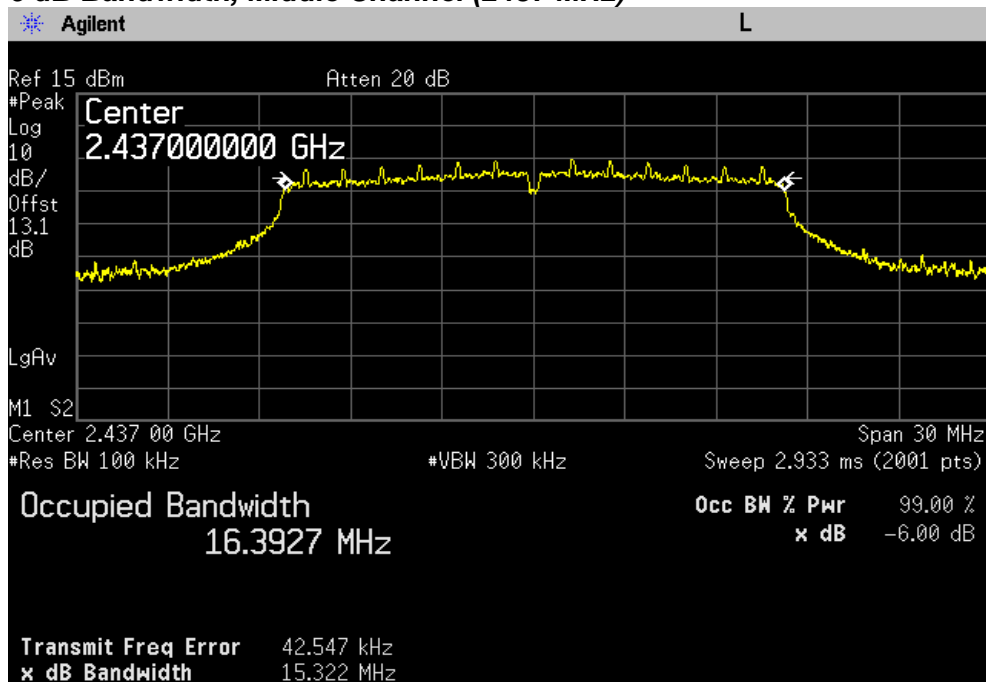
PLOTS OF EMISSIONS

802.11g mode

6 dB Bandwidth, Lowest Channel (2412 MHz)

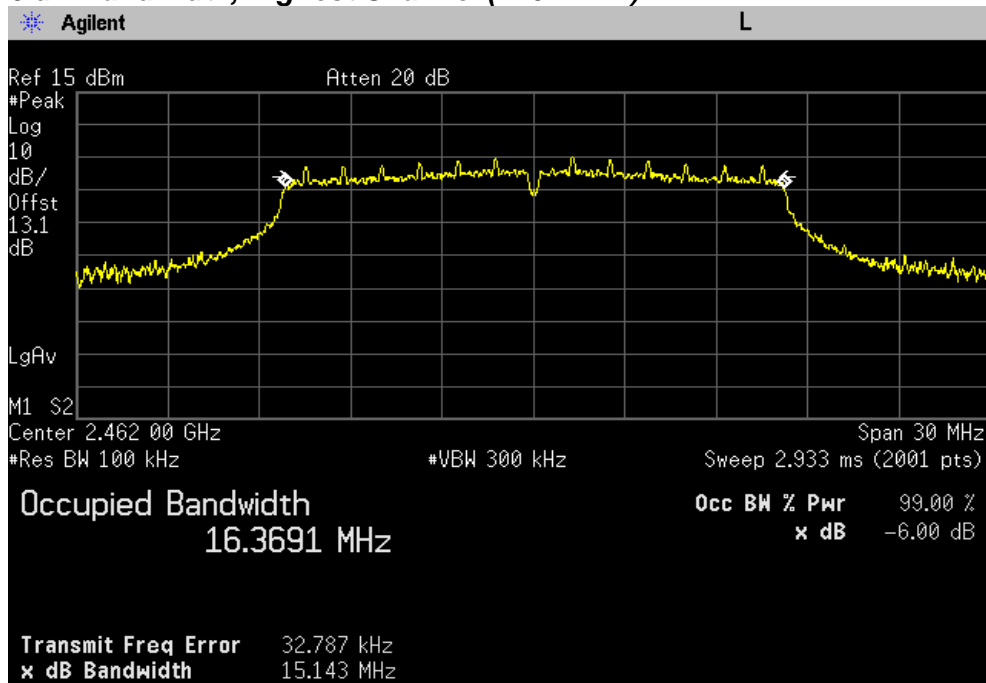


6 dB Bandwidth, Middle Channel (2437 MHz)



PLOTS OF EMISSIONS

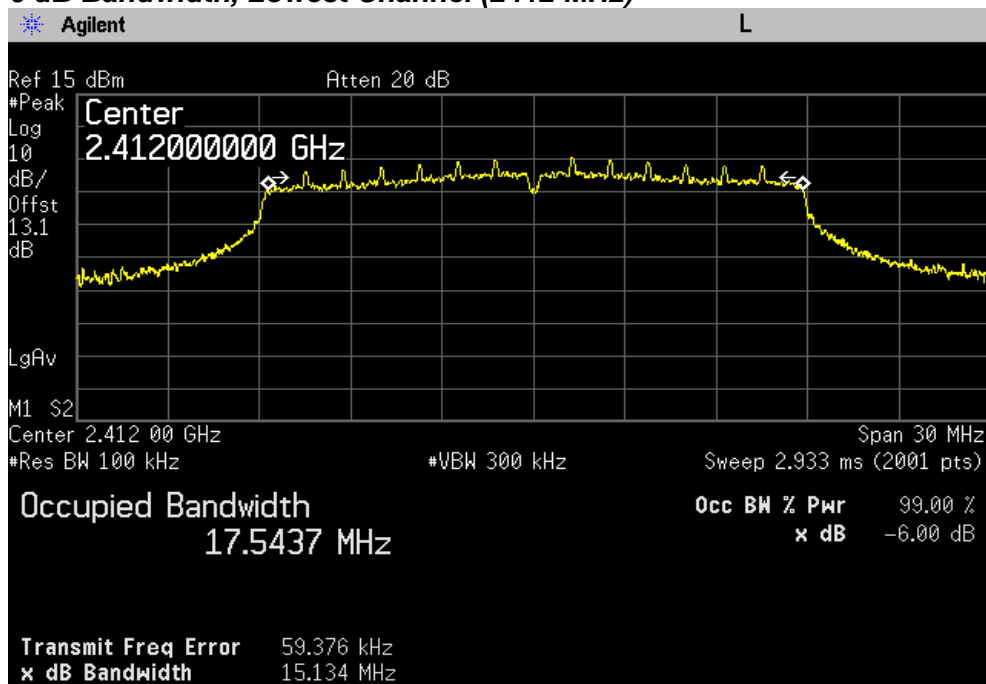
6 dB Bandwidth, Highest Channel (2462 MHz)



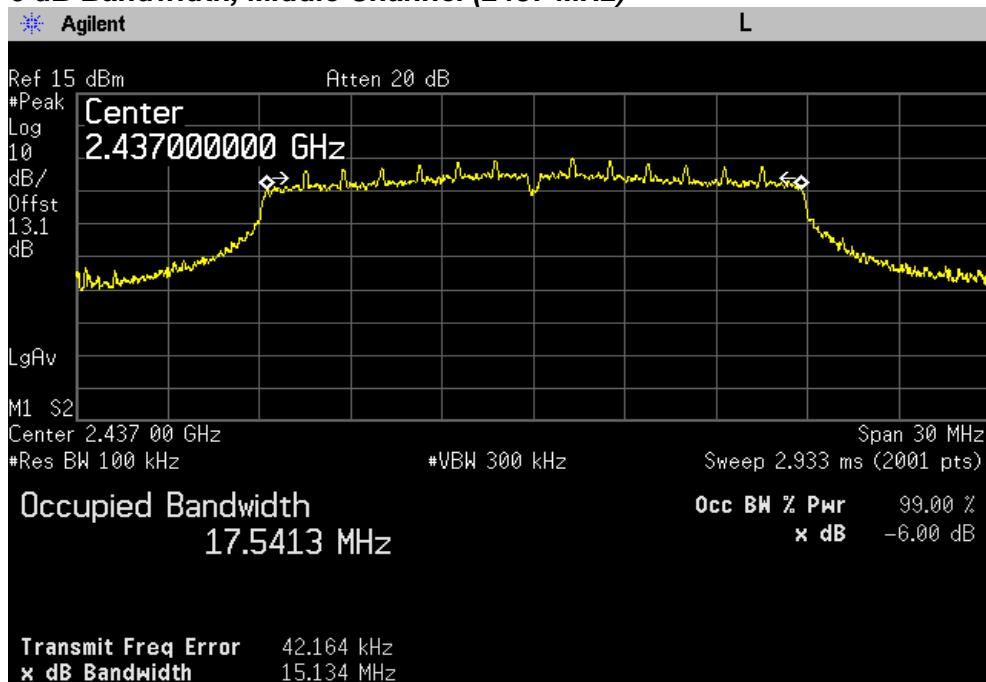
PLOTS OF EMISSIONS

802.11n mode

6 dB Bandwidth, Lowest Channel (2412 MHz)

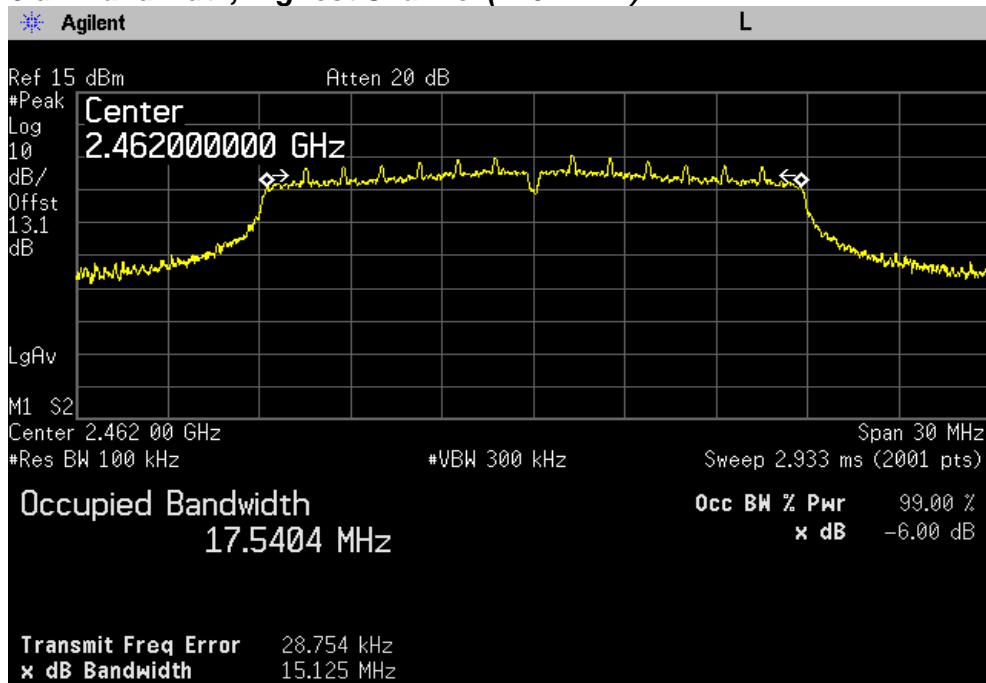


6 dB Bandwidth, Middle Channel (2437 MHz)



PLOTS OF EMISSIONS

6 dB Bandwidth, Highest Channel (2462 MHz)



TEST DATA

8.5 Maximum peak conducted power

FCC §15.247(b)(3)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

802.11b

Frequency (MHz)	Data rate (Mbps)	Conducted Output Power (dBm)	Limit (dBm)	Margin (dB)
2412	1	2.10	30.00	27.90
	2	2.18	30.00	27.82
	5.5	3.67	30.00	26.33
	11	5.44	30.00	24.56
2436	1	1.88	30.00	28.12
	2	1.75	30.00	28.25
	5.5	3.16	30.00	26.84
	11	5.08	30.00	24.92
2462	1	2.19	30.00	27.81
	2	2.68	30.00	27.32
	5.5	3.63	30.00	26.37
	11	5.85	30.00	24.15

802.11g

Frequency (MHz)	Data rate (Mbps)	Conducted Output Power (dBm)	Limit (dBm)	Margin (dB)
2412	6	12.63	30.00	17.37
	9	12.02	30.00	17.98
	12	12.47	30.00	17.53
	18	12.19	30.00	17.81
	24	12.23	30.00	17.77
	36	12.55	30.00	17.45
	48	12.89	30.00	17.11
	54	12.48	30.00	17.52
2437	6	12.48	30.00	17.52
	9	11.52	30.00	18.48
	12	11.64	30.00	18.36
	18	11.59	30.00	18.41
	24	12.13	30.00	17.87
	36	12.47	30.00	17.53
	48	12.02	30.00	17.98
	54	12.24	30.00	17.76
2462	6	12.31	30.00	17.69
	9	11.76	30.00	18.24
	12	11.89	30.00	18.11
	18	11.79	30.00	18.21
	24	12.50	30.00	17.50
	36	12.17	30.00	17.83
	48	12.32	30.00	17.68
	54	12.34	30.00	17.66

802.11n

Frequency (MHz)	Data rate (Mbps)	Conducted Output Power (dBm)	Limit (dBm)	Margin (dB)
2412	MCS0	12.01	30.00	17.99
	MCS1	11.48	30.00	18.52
	MCS2	11.50	30.00	18.50
	MCS3	12.06	30.00	17.94
	MCS4	11.92	30.00	18.08
	MCS5	12.24	30.00	17.76
	MCS6	12.02	30.00	17.98
	MCS7	11.92	30.00	18.08
2437	MCS0	11.48	30.00	18.52
	MCS1	11.10	30.00	18.90
	MCS2	11.23	30.00	18.77
	MCS3	11.57	30.00	18.43
	MCS4	11.47	30.00	18.53
	MCS5	11.21	30.00	18.79
	MCS6	11.56	30.00	18.44
	MCS7	11.62	30.00	18.38
2462	MCS0	12.51	30.00	17.49
	MCS1	11.76	30.00	18.24
	MCS2	11.61	30.00	18.39
	MCS3	12.19	30.00	17.81
	MCS4	11.98	30.00	18.02
	MCS5	12.03	30.00	17.97
	MCS6	12.28	30.00	17.72
	MCS7	12.22	30.00	17.78

Note(s):

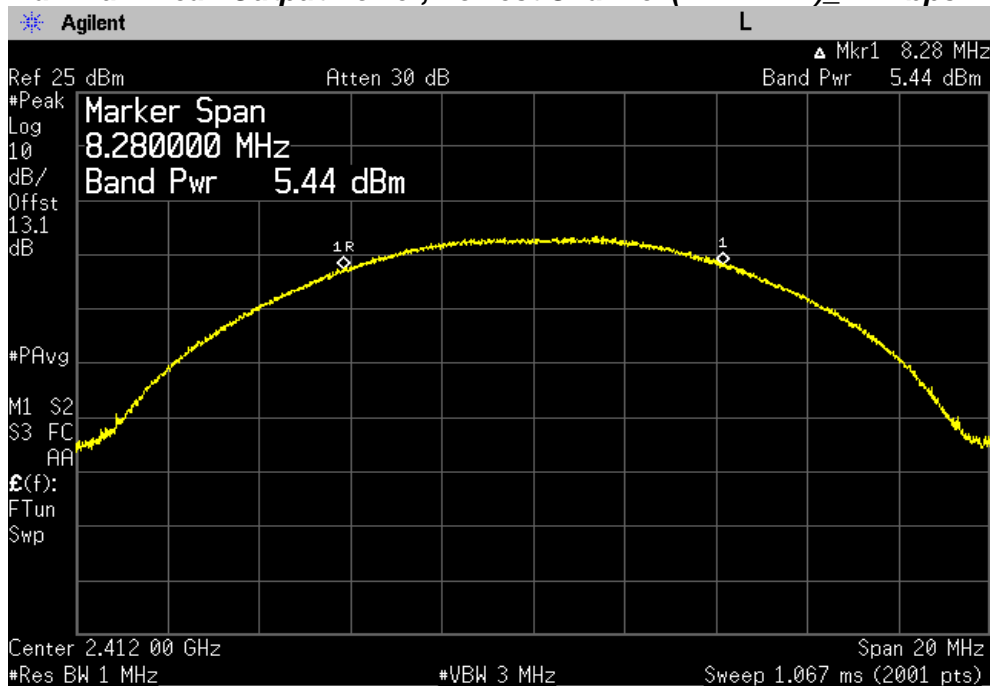
The following equation was used for spectrum offset:

$\text{Spectrum offset (dB)} = \text{Attenuator (dB)} + \text{Cable Loss (dB)} + \text{SMA Type Connector Loss (dB)}$

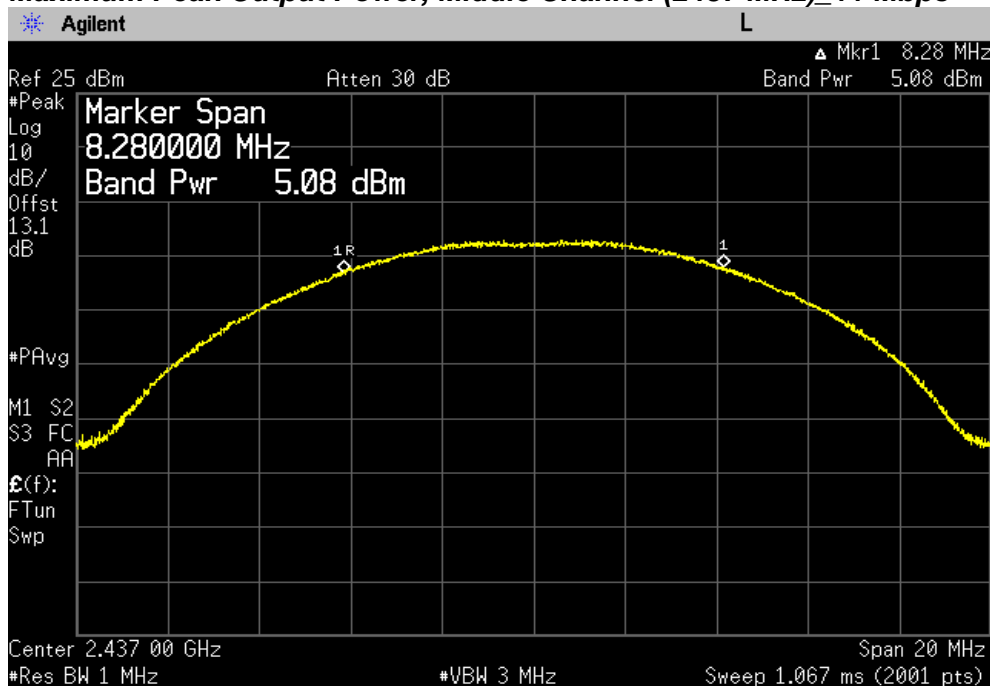
PLOT OF TEST DATA

802.11b mode

Maximum Peak Output Power, Lowest Channel (2412 MHz)_ 11 Mbps

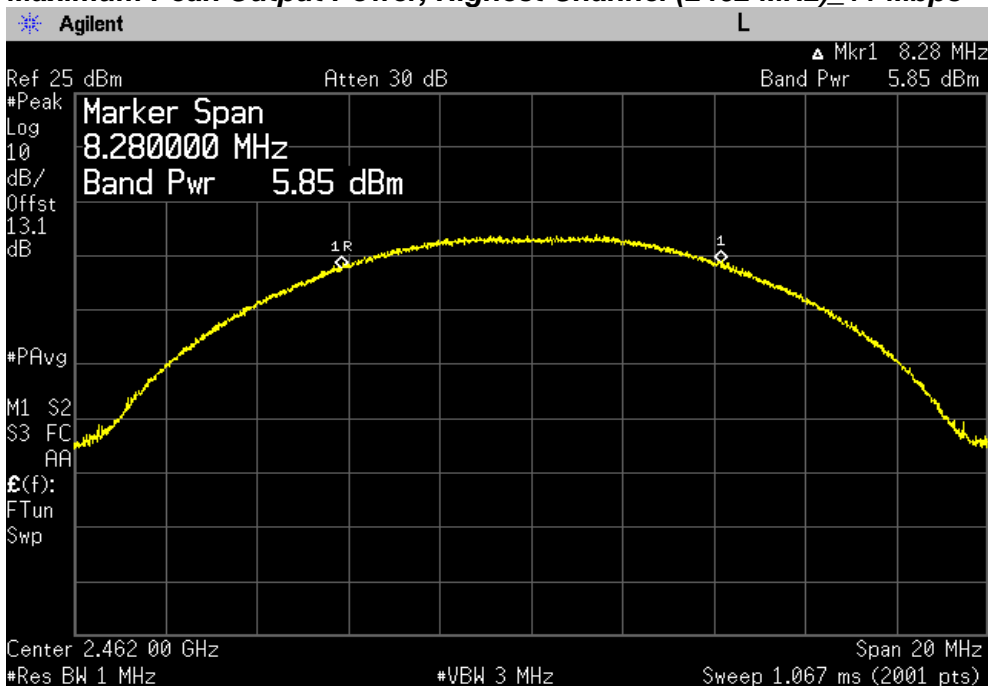


Maximum Peak Output Power, Middle Channel (2437 MHz)_ 11 Mbps



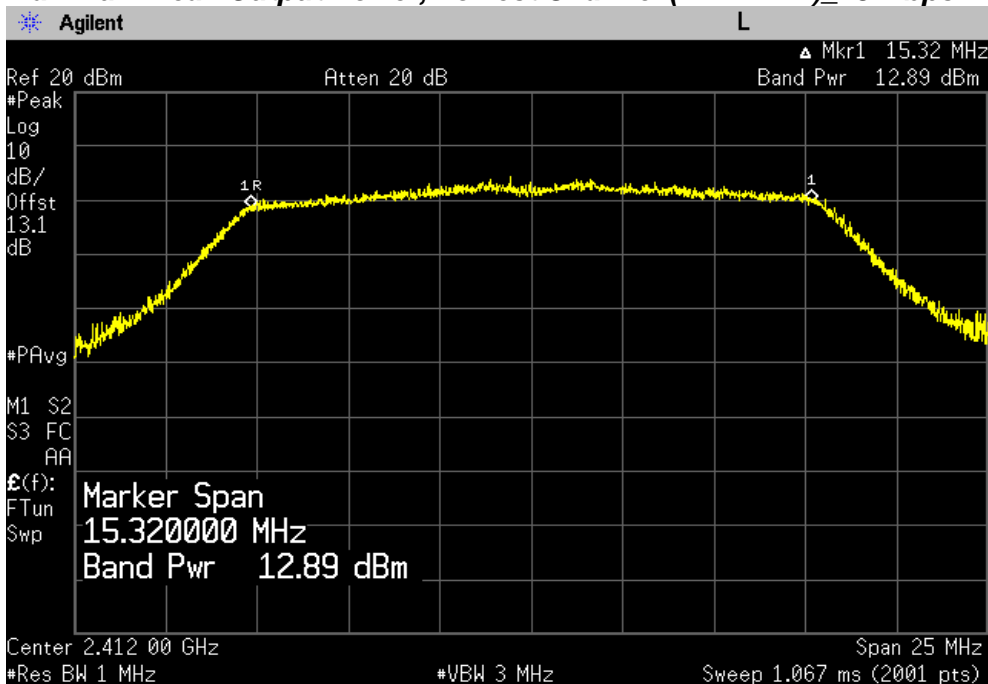
PLOT OF TEST DATA

Maximum Peak Output Power, Highest Channel (2462 MHz)_ 11 Mbps



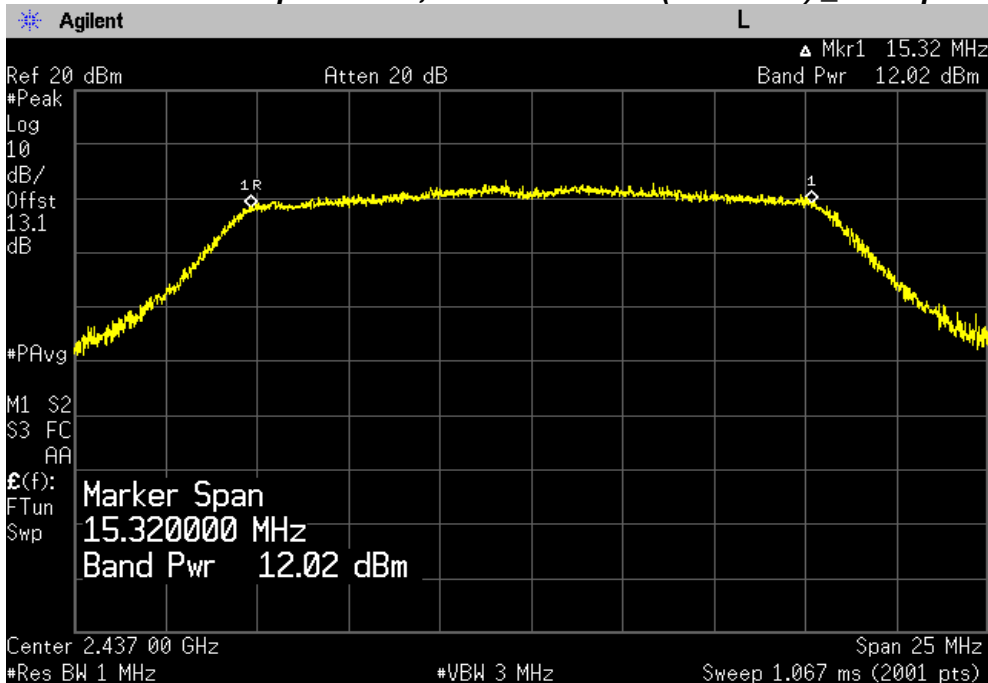
802.11g mode

Maximum Peak Output Power, Lowest Channel (2412 MHz)_ 48 Mbps

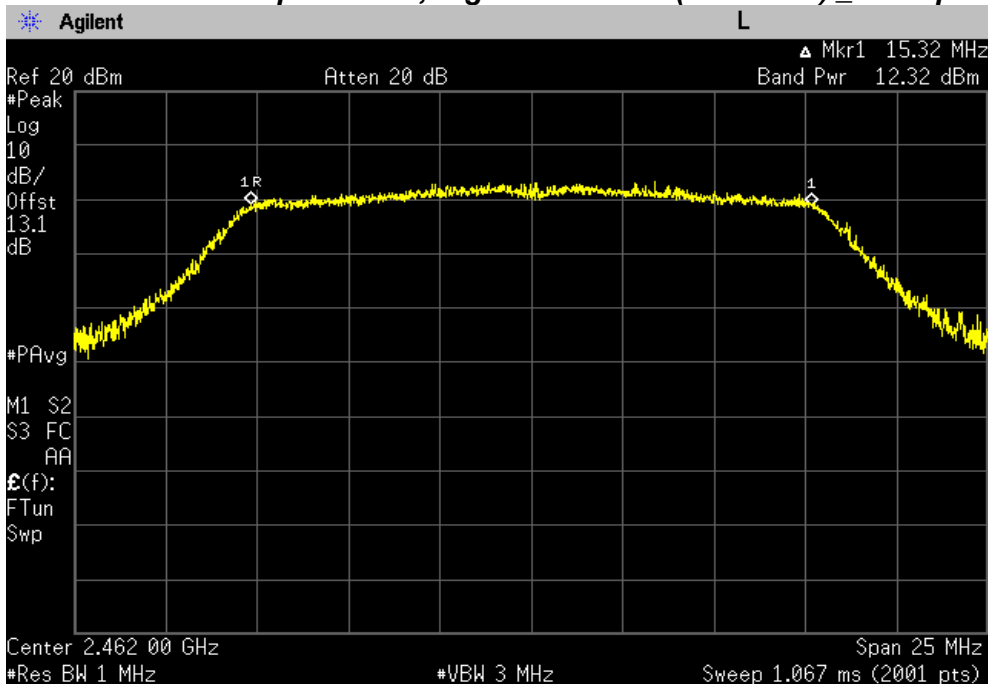


PLOT OF TEST DATA

Maximum Peak Output Power, Middle Channel (2437 MHz) _48 Mbps



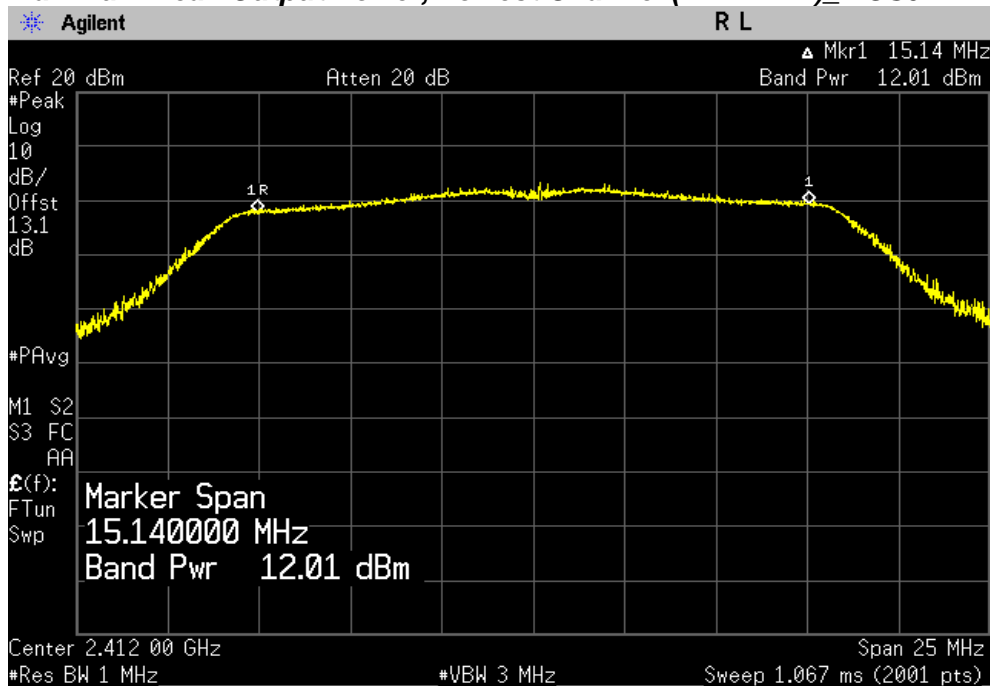
Maximum Peak Output Power, Highest Channel (2462 MHz) _48 Mbps



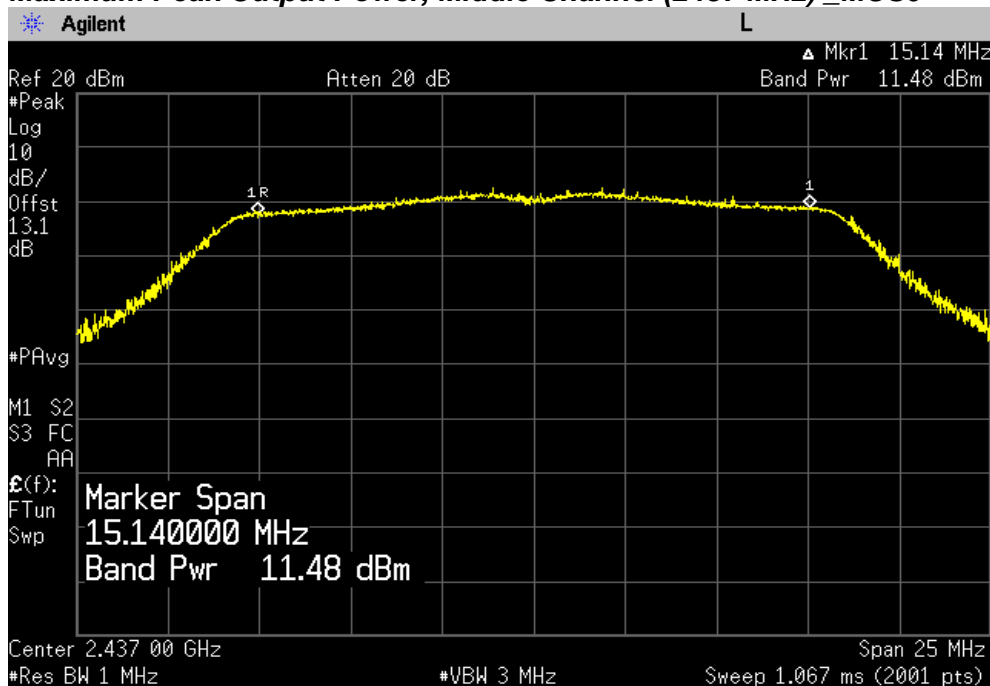
PLOT OF TEST DATA

802.11n mode

Maximum Peak Output Power, Lowest Channel (2412 MHz)_MCS0



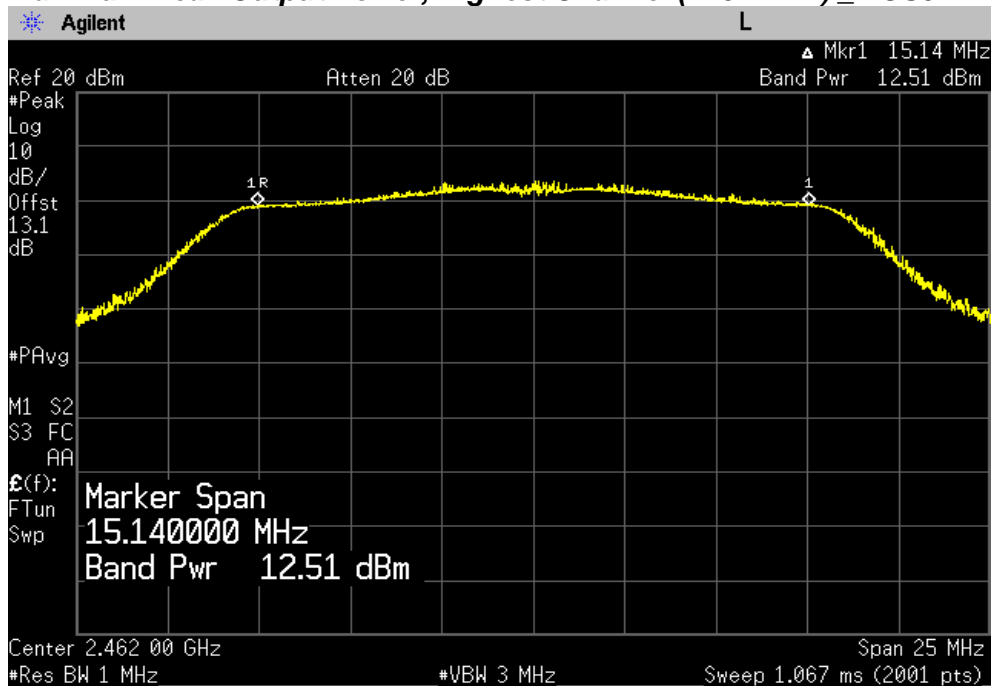
Maximum Peak Output Power, Middle Channel (2437 MHz)_MCS0



PLOT OF TEST DATA

802.11n mode

Maximum Peak Output Power, Highest Channel (2462 MHz) _MCS0



TEST DATA

8.6 Power Spectral Density

FCC §15.247(e)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

802.11b

Channel	Frequency(MHz)	Result(dBm)	Limit (dBm)
Low	2412	-6.98	8.0
Middle	2437	-8.57	8.0
High	2462	-8.16	8.0

802.11g

Channel	Frequency(MHz)	Result(dBm)	Limit (dBm)
Low	2412	-4.44	8.0
Middle	2437	-5.52	8.0
High	2462	-4.97	8.0

802.11n

Channel	Frequency(MHz)	Result(dBm)	Limit (dBm)
Low	2412	-4.55	8.0
Middle	2437	-4.90	8.0
High	2462	-4.31	8.0

Note(s):

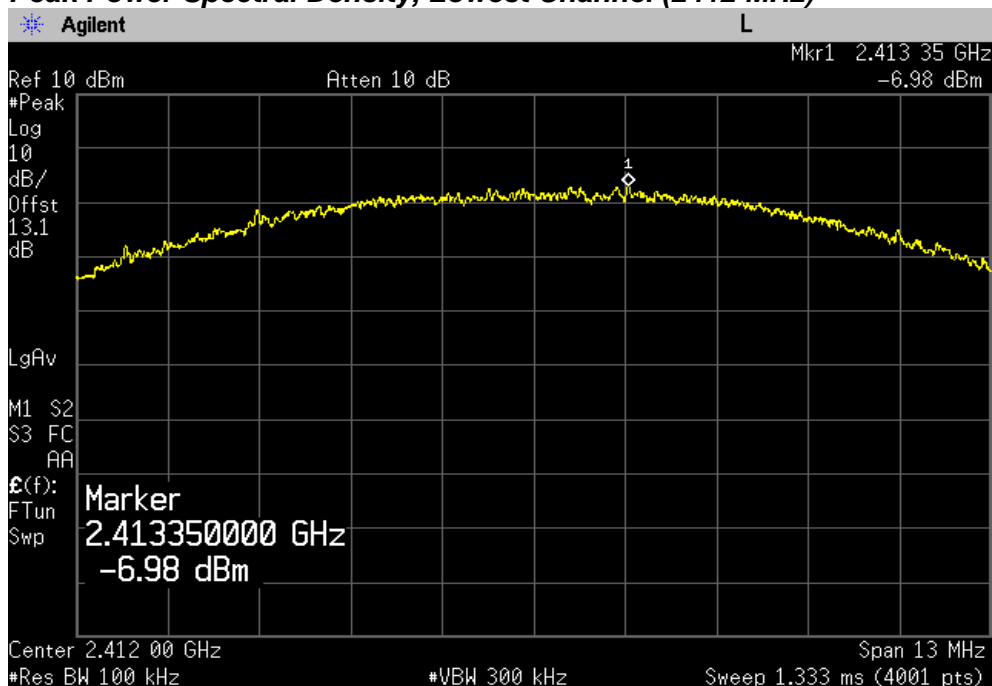
The following equation was used for spectrum offset:

Spectrum offset (dB) = Attenuator (dB) + Cable Loss (dB) + SMA Type Connector Loss (dB)

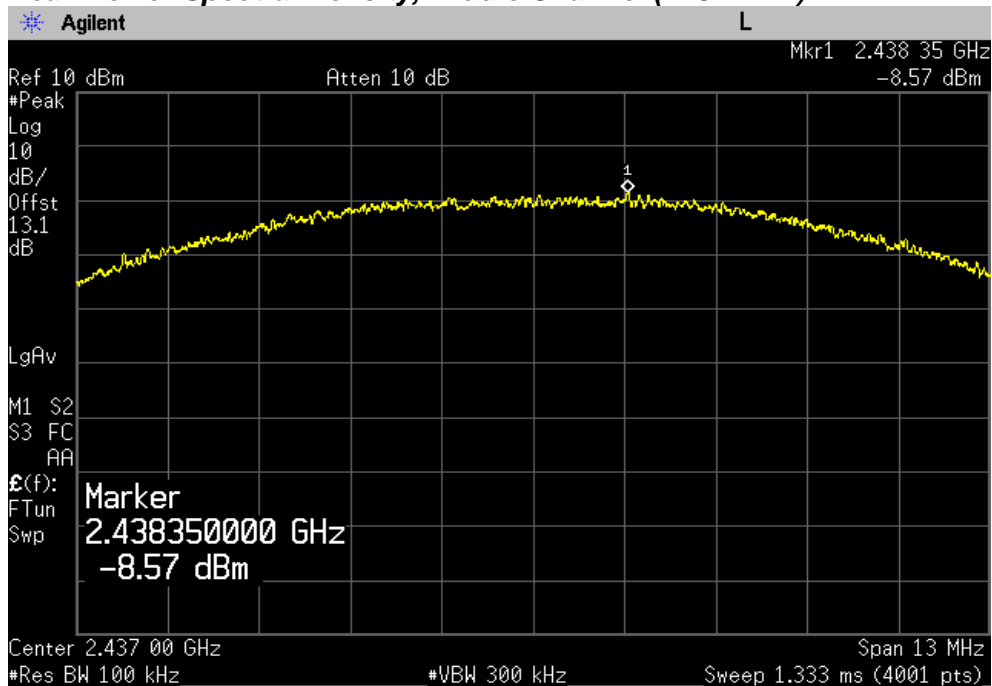
PLOT OF TEST DATA

802.11b mode

Peak Power Spectral Density, Lowest Channel (2412 MHz)

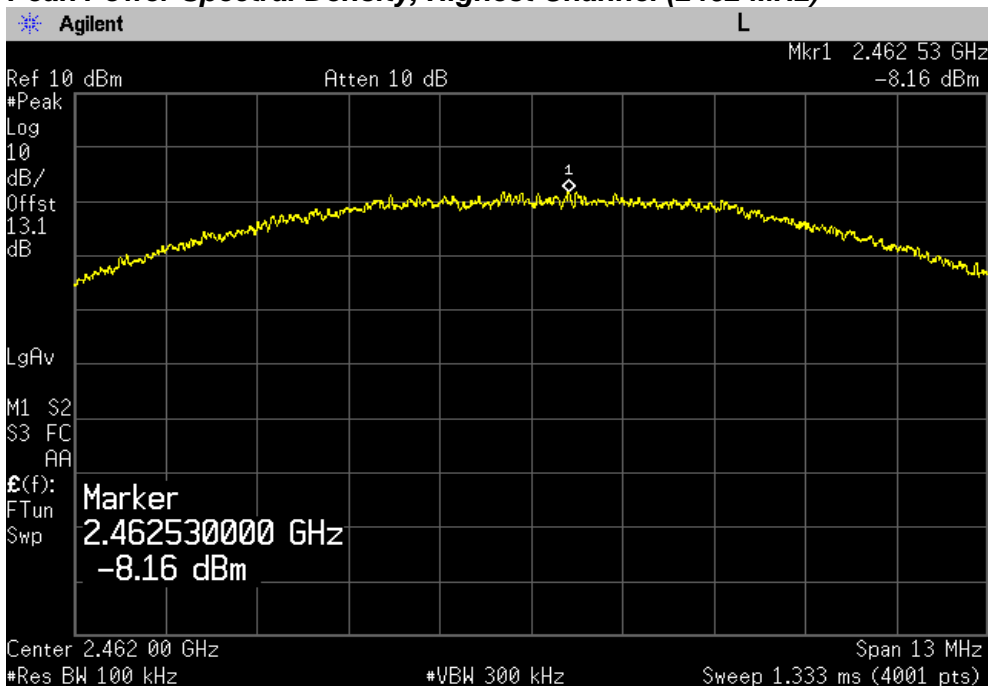


Peak Power Spectral Density, Middle Channel (2437 MHz)



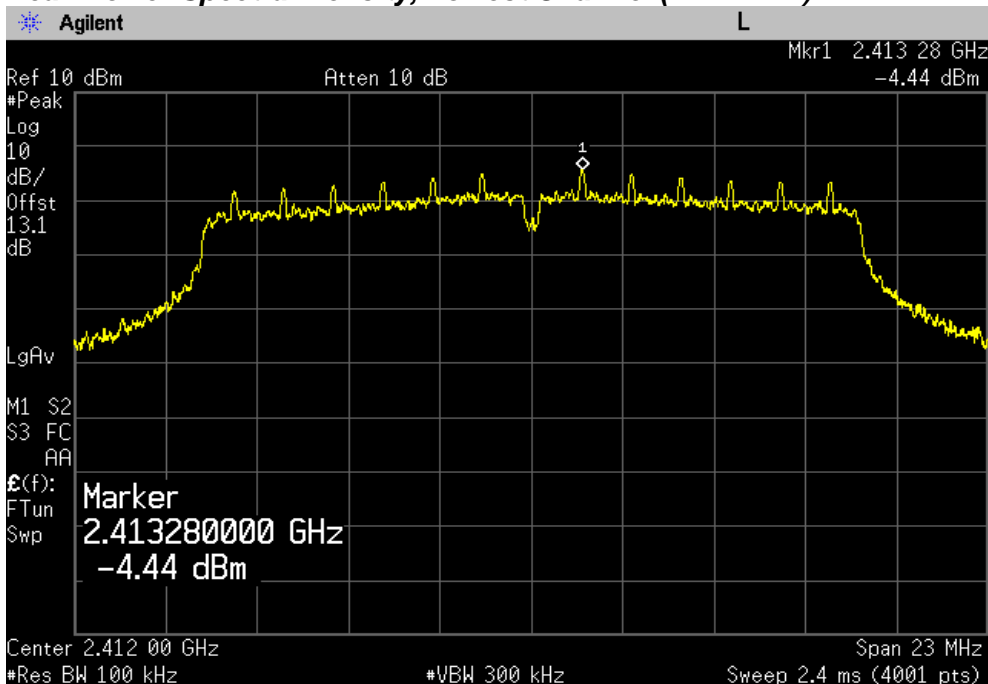
PLOT OF TEST DATA

Peak Power Spectral Density, Highest Channel (2462 MHz)



802.11g mode

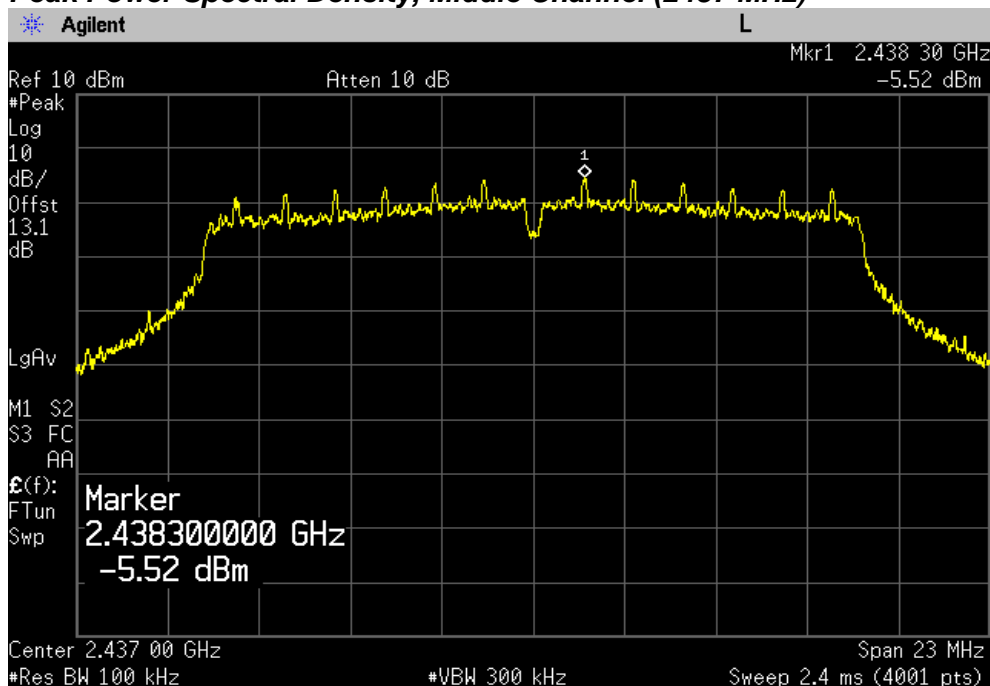
Peak Power Spectral Density, Lowest Channel (2412 MHz)



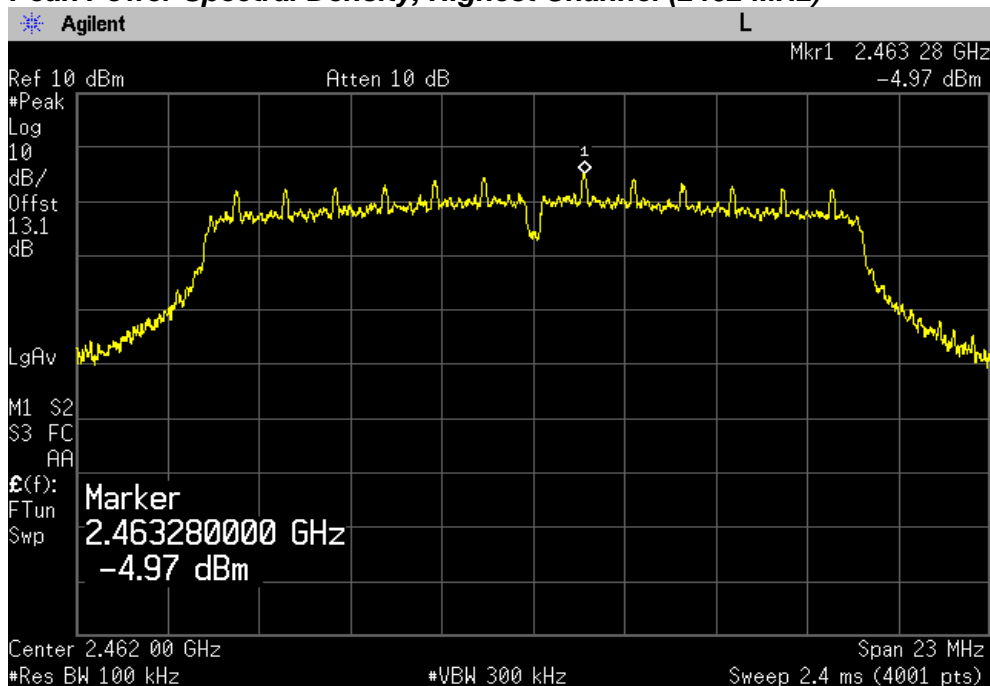
PLOT OF TEST DATA

802.11g mode

Peak Power Spectral Density, Middle Channel (2437 MHz)



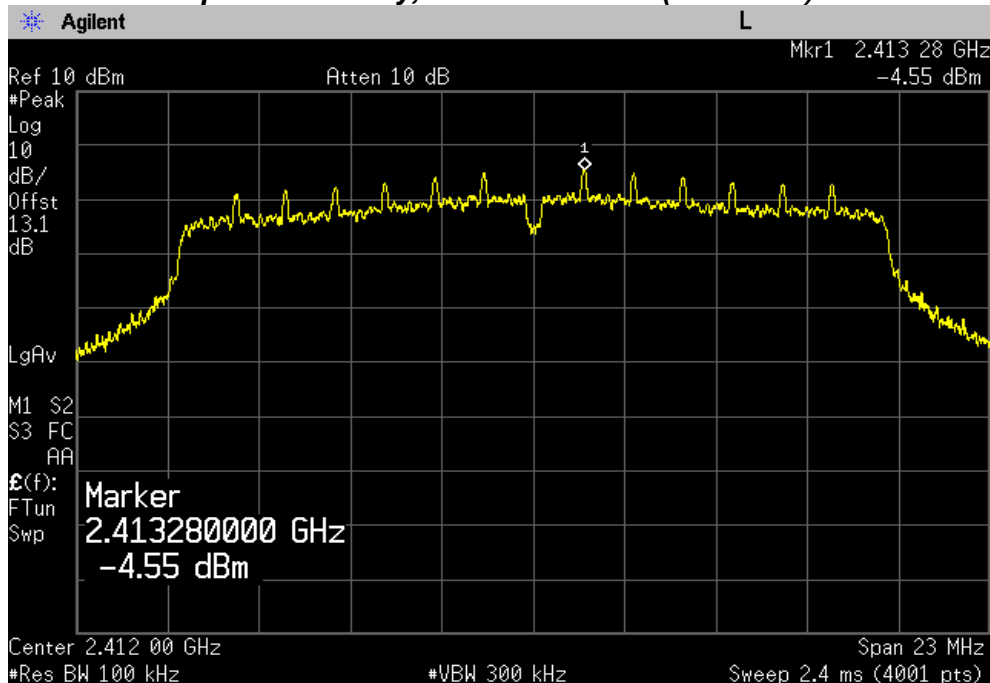
Peak Power Spectral Density, Highest Channel (2462 MHz)



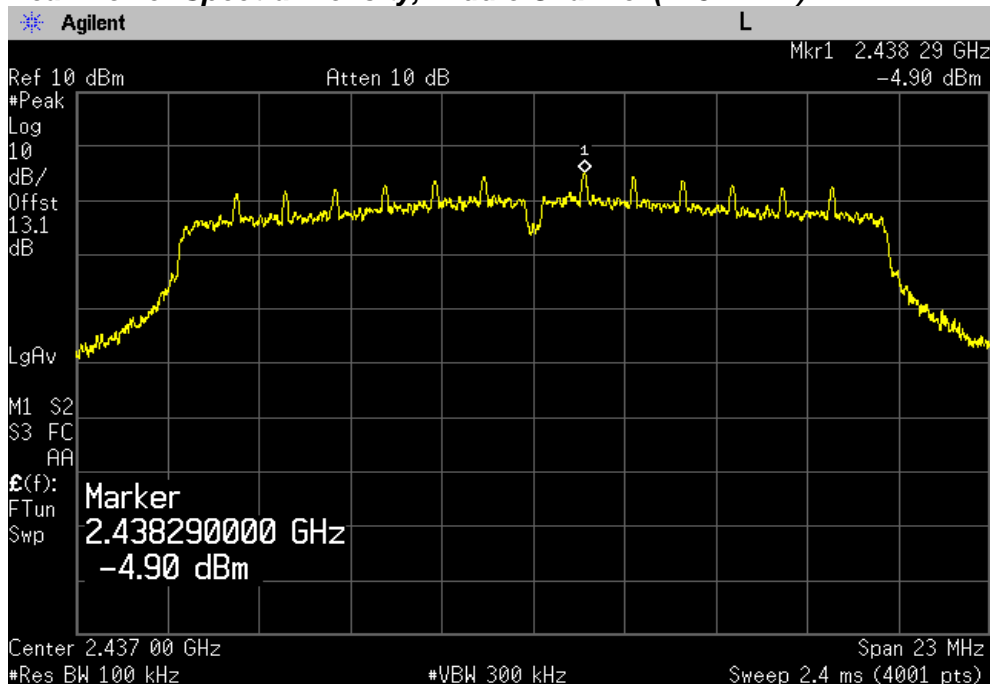
PLOT OF TEST DATA

802.11n mode

Peak Power Spectral Density, Lowest Channel (2412 MHz)

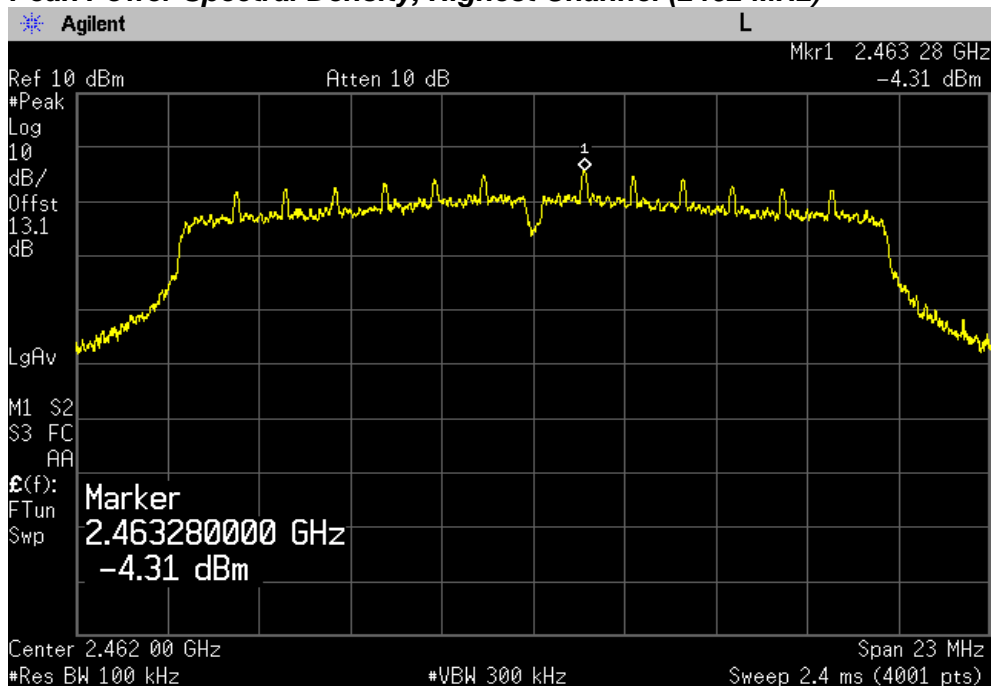


Peak Power Spectral Density, Middle Channel (2437 MHz)



PLOT OF TEST DATA

Peak Power Spectral Density, Highest Channel (2462 MHz)



TEST DATA

8.7 Conducted Spurious Emissions

FCC §15.247(d)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

802.11b mode

Channel	Frequency (MHz)	Reference Level (dBm)	Conducted Spurious Emissions (dBc)	Limit (dBc)
Low	2412	-6.98	More than 20 dBc	20
Middle	2437	-8.57	More than 20 dBc	20
High	2462	-8.16	More than 20 dBc	20

802.11g mode

Channel	Frequency (MHz)	Reference Level (dBm)	Conducted Spurious Emissions (dBc)	Limit (dBc)
Low	2412	-4.44	More than 20 dBc	20
Middle	2437	-5.52	More than 20 dBc	20
High	2462	-4.97	More than 20 dBc	20

802.11n mode

Channel	Frequency (MHz)	Reference Level (dBm)	Conducted Spurious Emissions (dBc)	Limit (dBc)
Low	2412	-4.55	More than 20 dBc	20
Middle	2437	-4.90	More than 20 dBc	20
High	2462	-4.31	More than 20 dBc	20

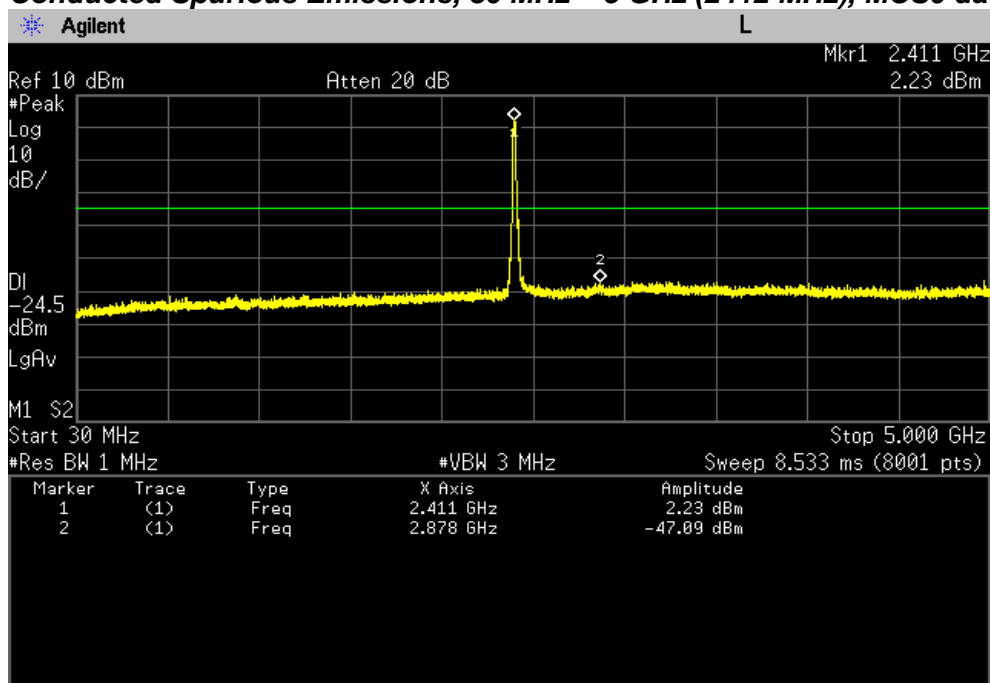
Notes:

1. *The cable and attenuator loss from 30 MHz to 25 GHz was reflected in spectrum analyzer with correction factor for the spurious emissions test.*
2. *RBW was set to 1 MHz rather than 100 kHz in order to increase the test span.*
3. *The display line shown in the following plots indicates the limit at 20 dB below the fundamental emission level measured in a 100 kHz bandwidth.*
4. *For plots showing conducted spurious emissions near the limit, the frequencies were investigated with a reduced RBW to ensure that no emissions were present.*
5. *For the following out of band conducted spurious emissions plots, the EUT was investigated in all available data rates for 802.11b,g,n modes. The worst case spurious emissions were found while transmitting in 802.11n mode at MCS0 and are shown in the plots below.*
6. *During the test, the sweep point was set 8001 for the conducted spurious emissions test and 4001 for the Band Edge test.*

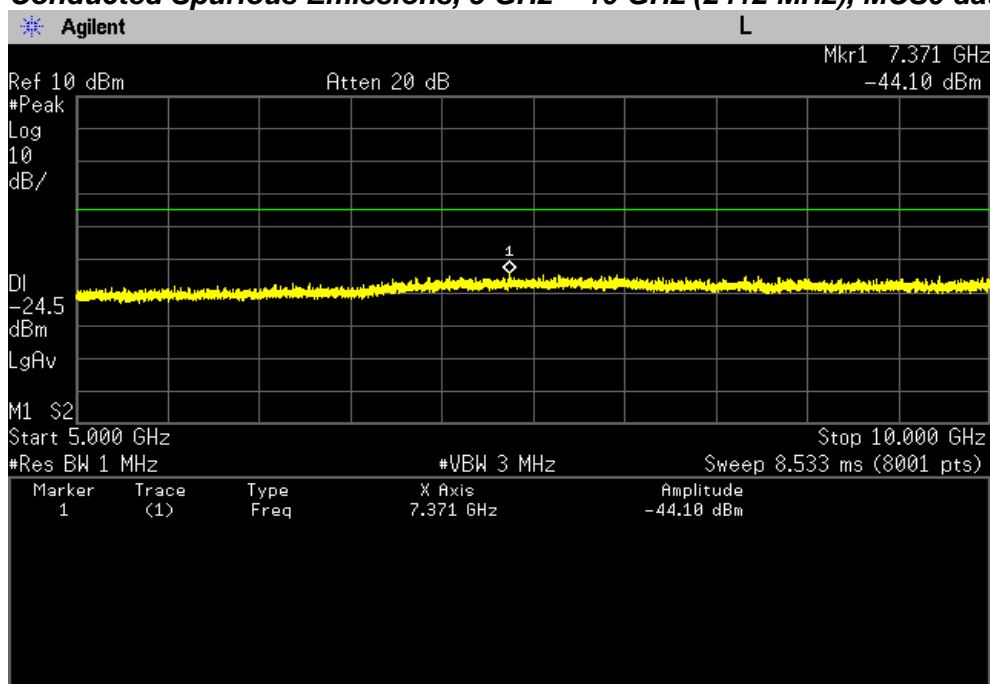
PLOT OF TEST DATA

802.11n mode

Conducted Spurious Emissions, 30 MHz ~ 5 GHz (2412 MHz), MCS0 data rate

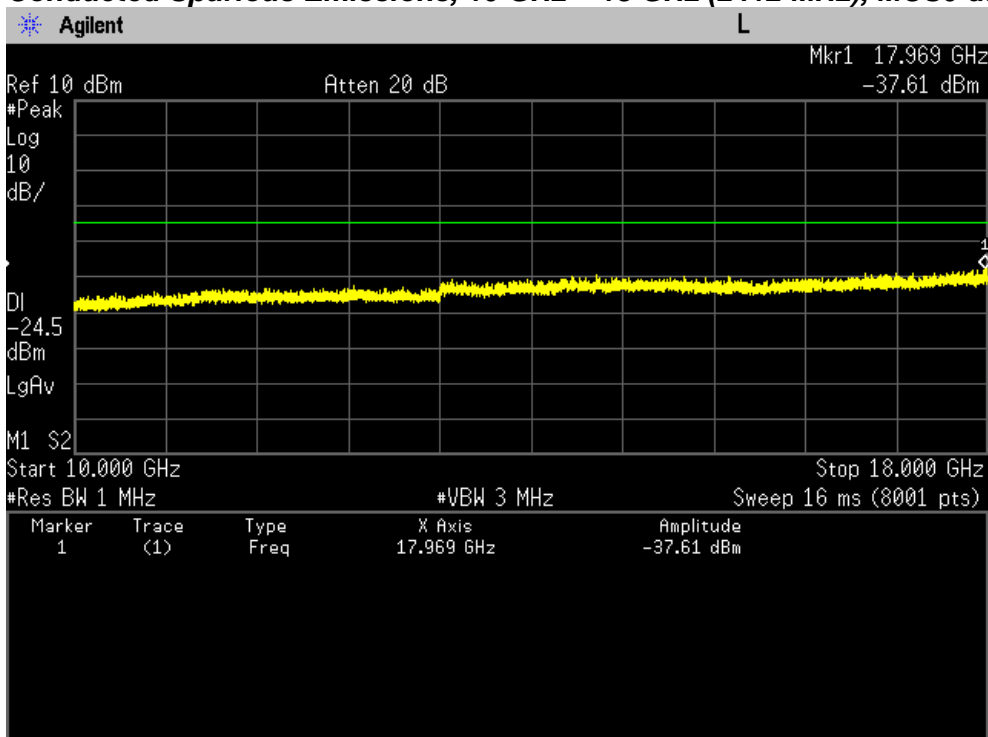


Conducted Spurious Emissions, 5 GHz ~ 10 GHz (2412 MHz), MCS0 data rate

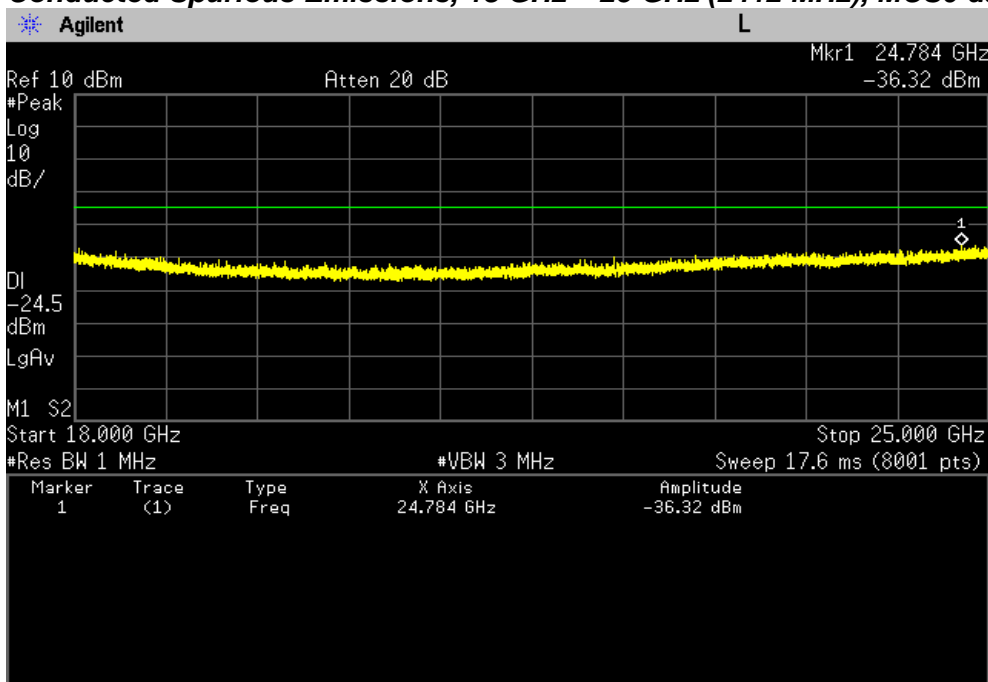


PLOT OF TEST DATA

Conducted Spurious Emissions, 10 GHz ~ 18 GHz (2412 MHz), MCS0 data rate

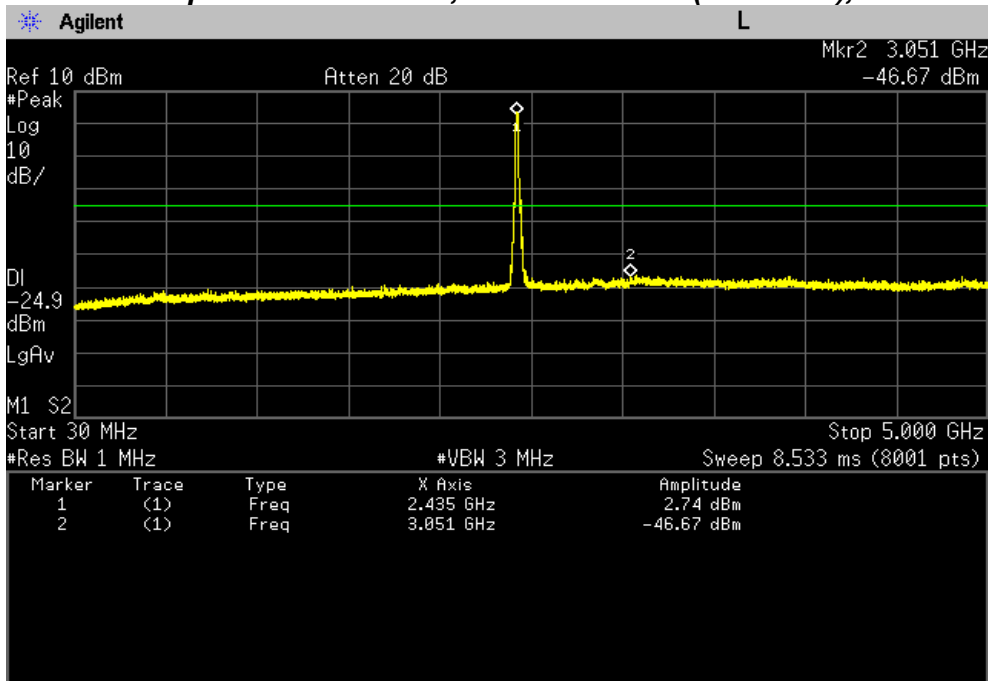


Conducted Spurious Emissions, 18 GHz ~ 25 GHz (2412 MHz), MCS0 data rate

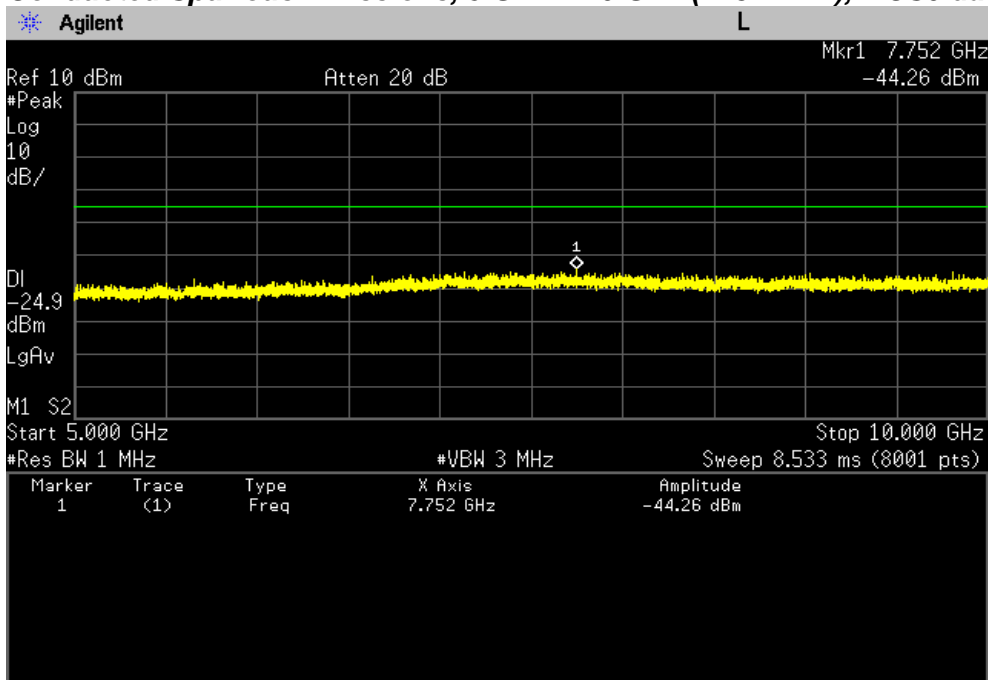


PLOT OF TEST DATA

Conducted Spurious Emissions, 30 MHz ~ 5 GHz (2437 MHz), MCS0 data rate

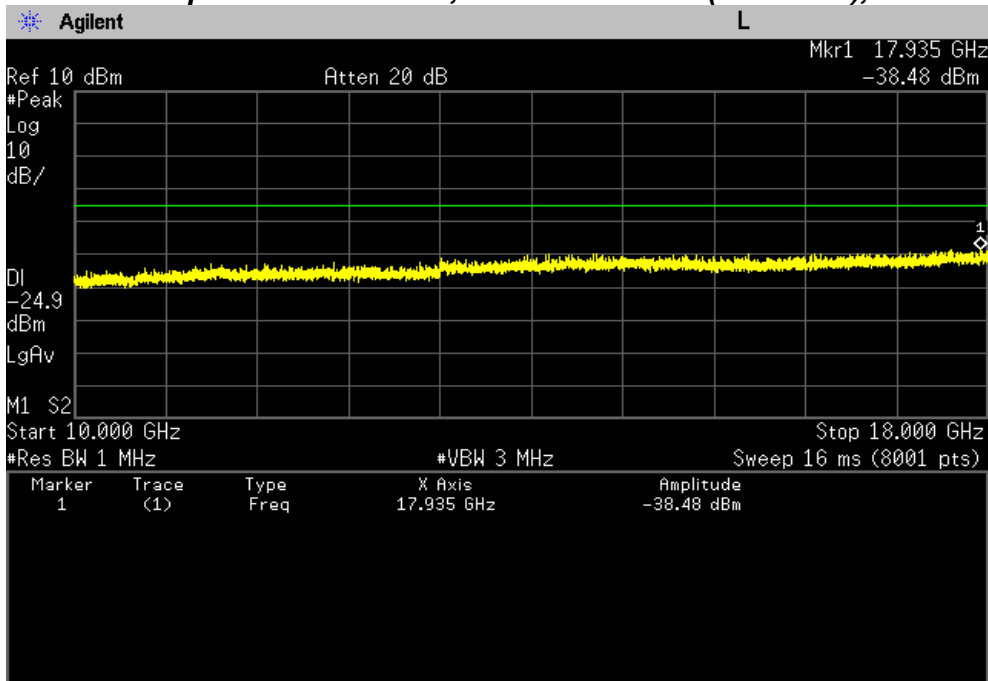


Conducted Spurious Emissions, 5 GHz ~ 10 GHz (2437 MHz), MCS0 data rate

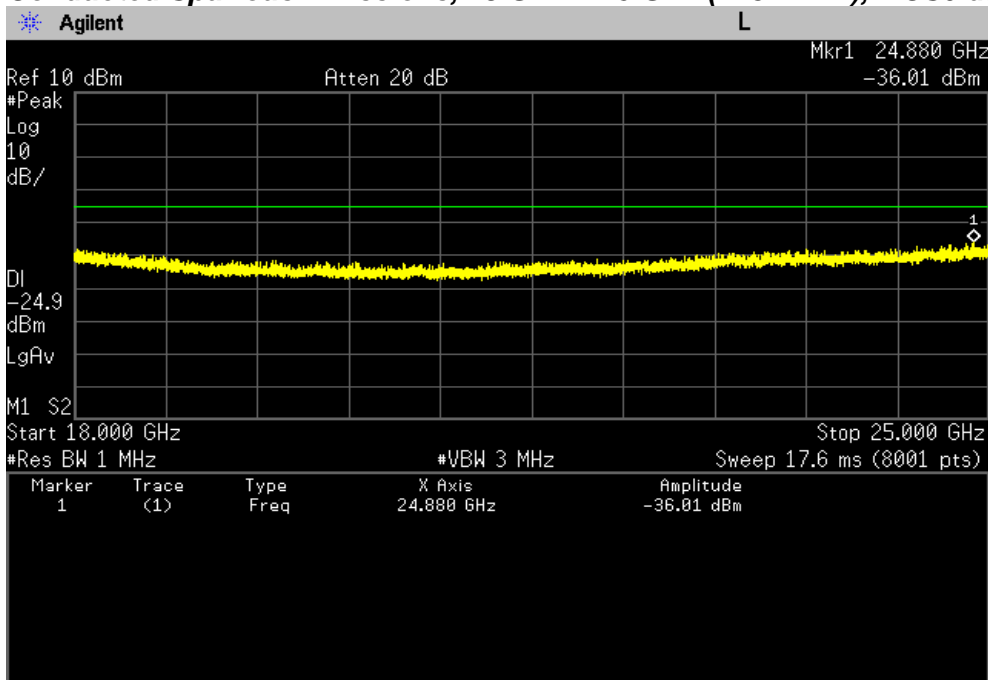


PLOT OF TEST DATA

Conducted Spurious Emissions, 10 GHz ~ 18 GHz (2437 MHz), MCS0 data rate

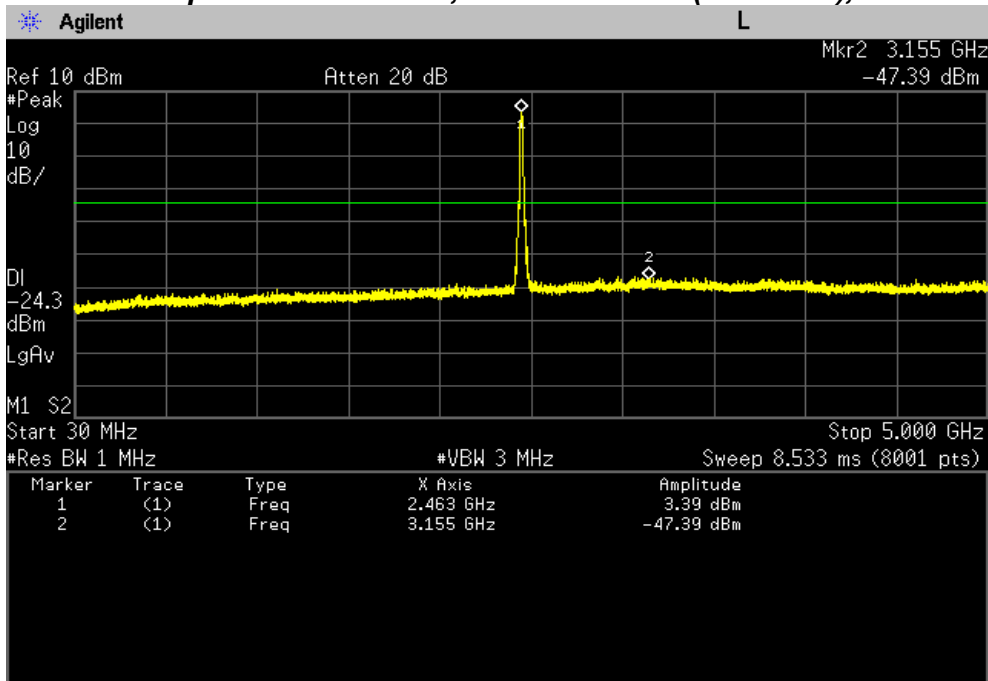


Conducted Spurious Emissions, 18 GHz ~ 25 GHz (2437 MHz), MCS0 data rate

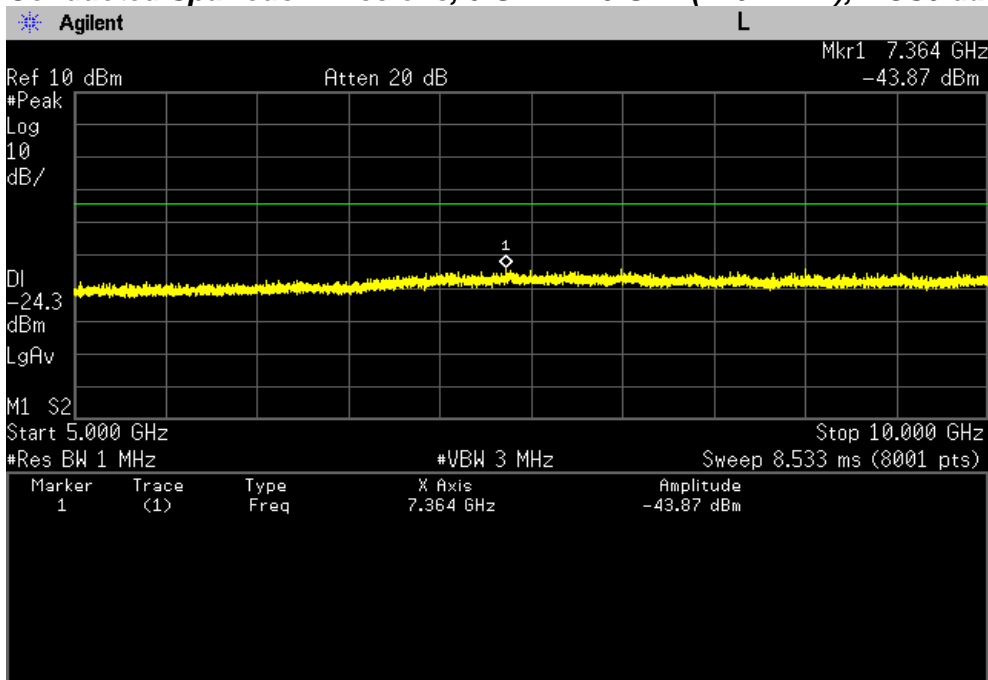


PLOT OF TEST DATA

Conducted Spurious Emissions, 30 MHz ~ 5 GHz (2462 MHz), MCS0 data rate

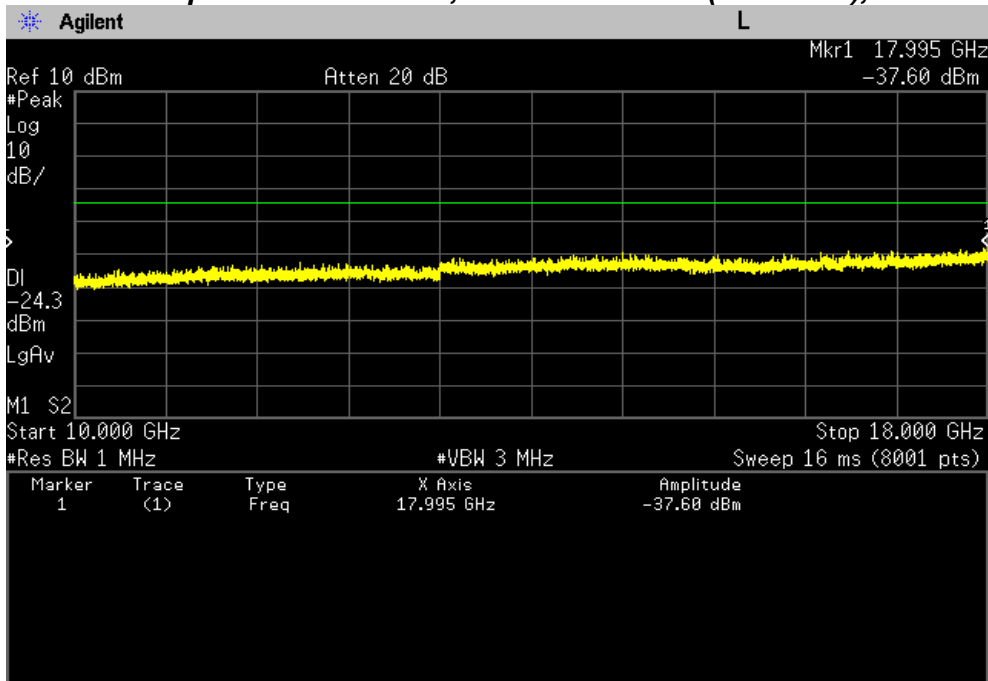


Conducted Spurious Emissions, 5 GHz ~ 10 GHz (2462 MHz), MCS0 data rate

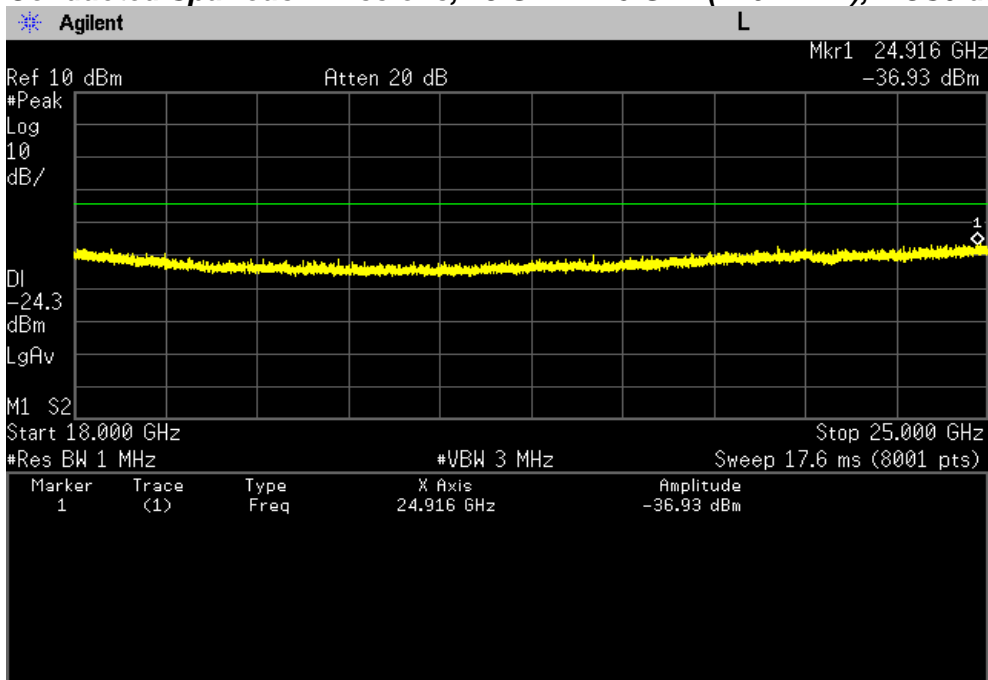


PLOT OF TEST DATA

Conducted Spurious Emissions, 10 GHz ~ 18 GHz (2462 MHz), MCS0 data rate



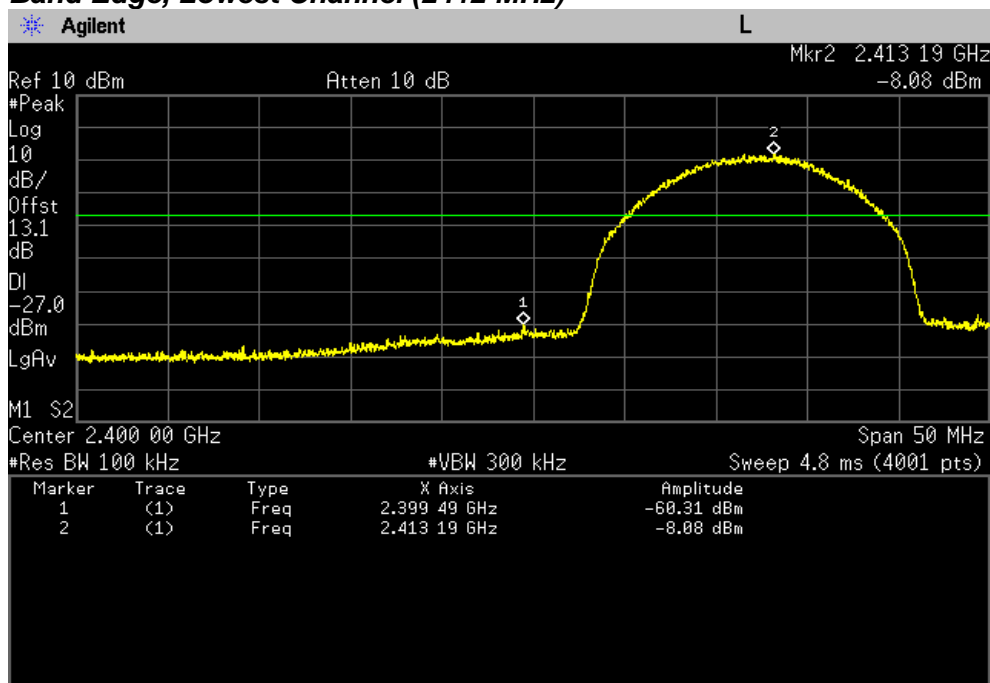
Conducted Spurious Emissions, 18 GHz ~ 25 GHz (2462 MHz), MCS0 data rate



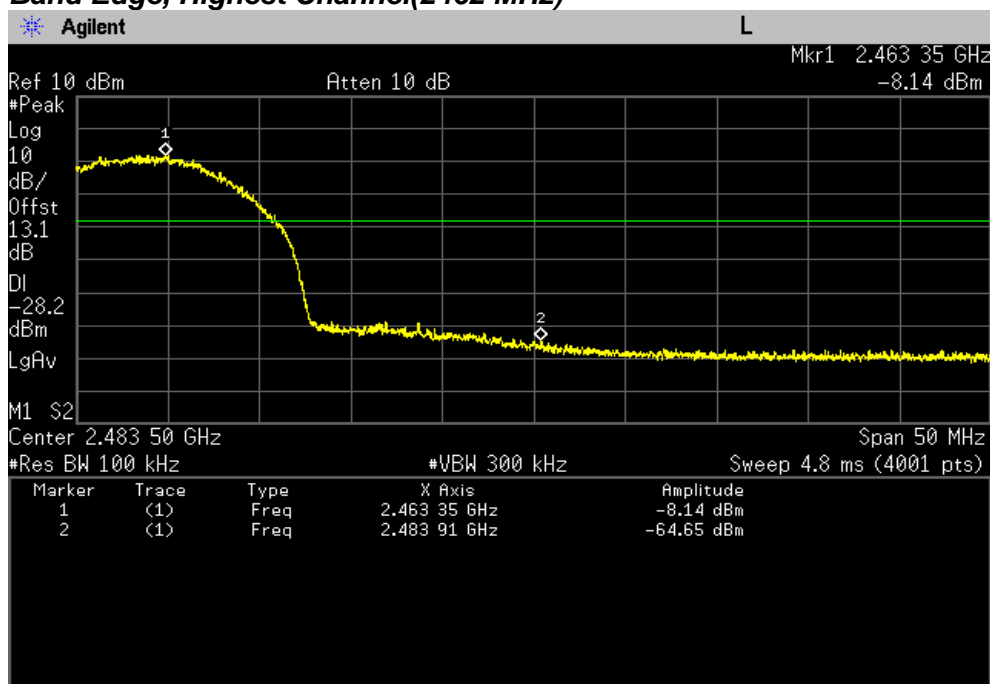
PLOT OF TEST DATA

802.11b mode

Band Edge, Lowest Channel (2412 MHz)



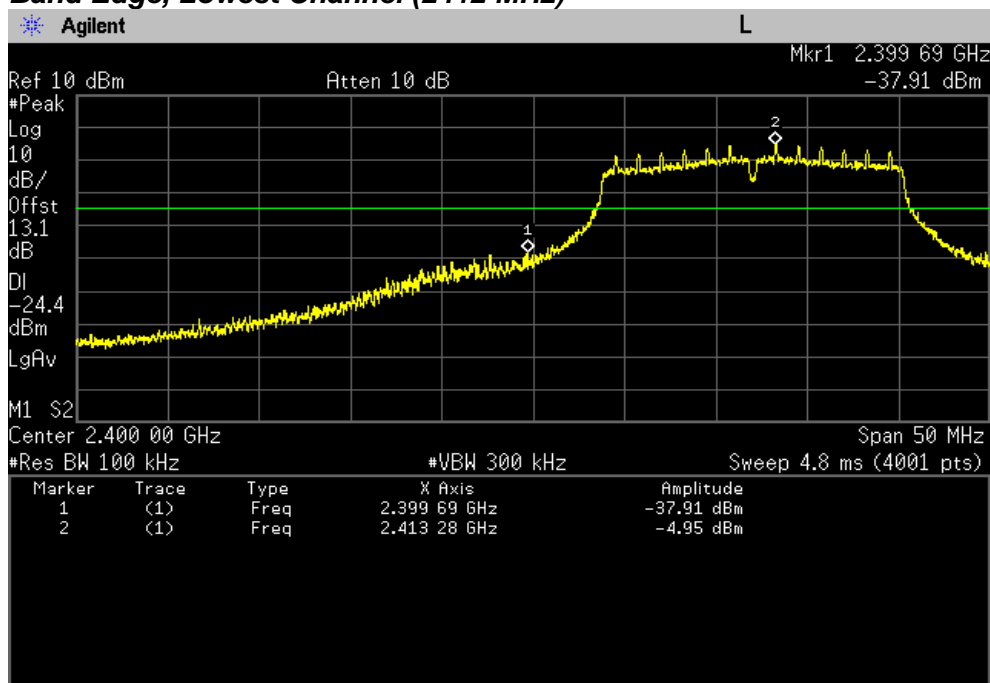
Band Edge, Highest Channel(2462 MHz)



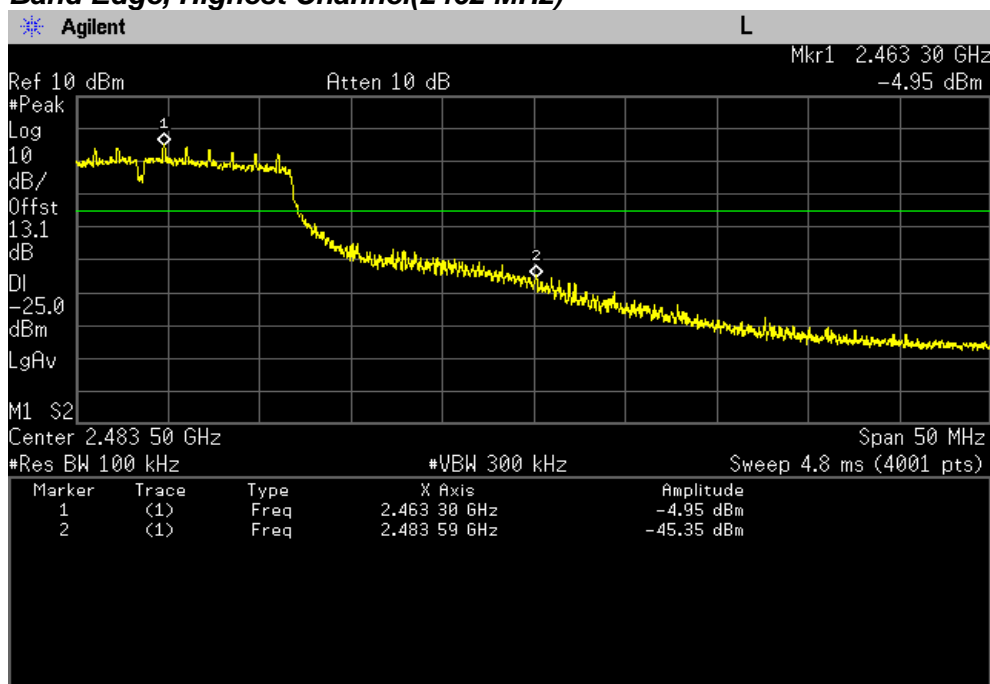
PLOT OF TEST DATA

802.11g mode

Band Edge, Lowest Channel (2412 MHz)



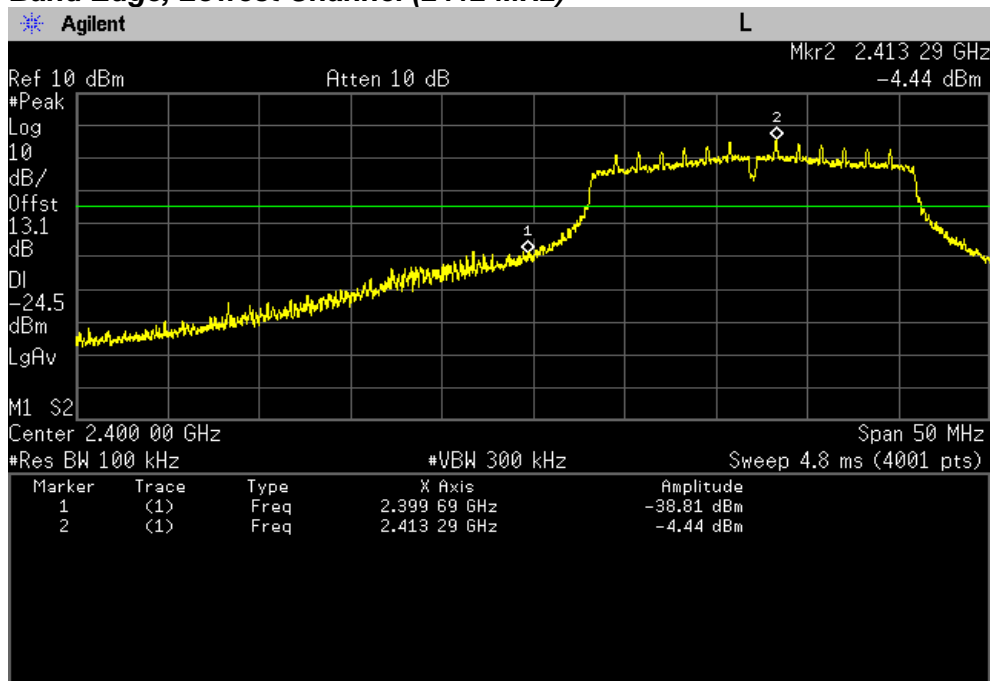
Band Edge, Highest Channel(2462 MHz)



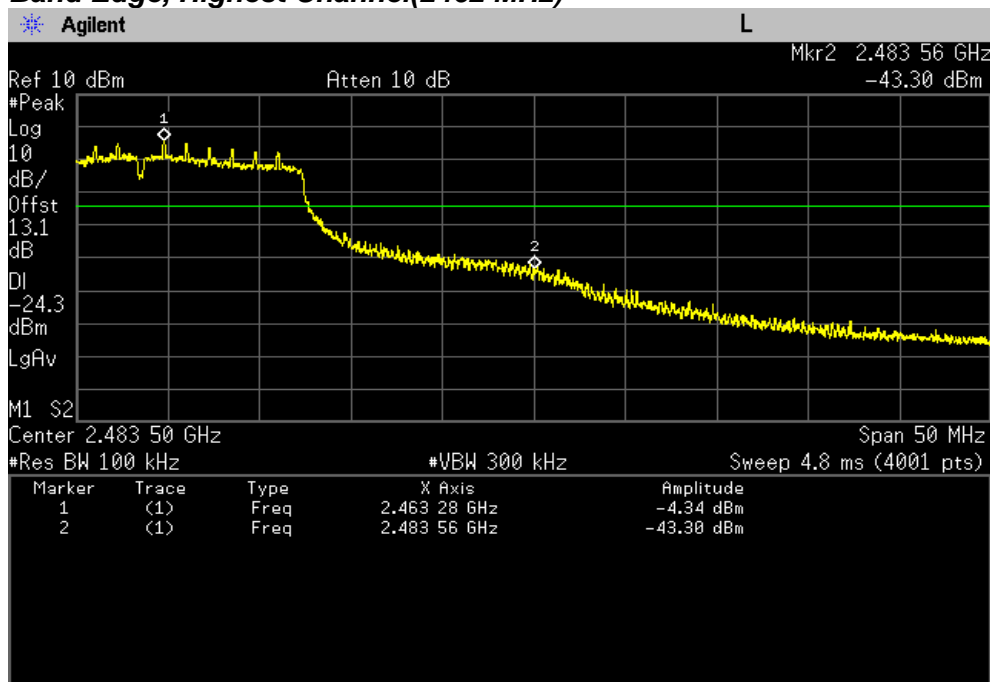
PLOT OF TEST DATA

802.11n mode

Band Edge, Lowest Channel (2412 MHz)



Band Edge, Highest Channel(2462 MHz)



TEST DATA

8.8 Radiated Spurious Emissions

FCC §15.247(d)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

802.11 b mode

Lowest Channel

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	DCF (dB)***	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1332.00	45.30	H	Pk	-4.00	-	41.30	74.00	32.70
1332.00	37.30	H	Av	-4.00	-	33.30	54.00	20.70
1499.00	47.80	H	Pk	-3.70	-	44.10	74.00	29.90
1499.00	38.60	H	Av	-3.70	-	34.90	54.00	19.10
1593.50	45.20	V	Pk	-3.40	-	41.80	74.00	32.20
1593.50	36.60	V	Av	-3.40	-	33.20	54.00	20.80
1661.25	49.00	V	Pk	-3.20	-	45.80	74.00	28.20
1661.25	39.80	V	Av	-3.20	-	36.60	54.00	17.40
2246.50	45.90	V	Pk	-1.40	-	44.50	74.00	29.50
2246.50	37.80	V	Av	-1.40	-	36.40	54.00	17.60
4823.75	42.90	V	Pk	9.20	-	52.10	74.00	21.90
4823.75	38.70	V	Av	9.20	-	47.90	54.00	6.10

Middle Channel

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	DCF (dB)***	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1328.00	46.10	H	Pk	-4.00	-	42.10	74.00	31.90
1328.00	38.00	H	Av	-4.00	-	34.00	54.00	20.00
1497.75	48.50	H	Pk	-3.70	-	44.80	74.00	29.20
1497.75	38.60	H	Av	-3.70	-	34.90	54.00	19.10
1596.75	45.70	V	Pk	-3.40	-	42.30	74.00	31.70
1596.75	36.80	V	Av	-3.40	-	33.40	54.00	20.60
1661.25	46.70	V	Pk	-3.20	-	43.50	74.00	30.50
1661.25	36.20	V	Av	-3.20	-	33.00	54.00	21.00
2242.50	46.50	V	Pk	-1.40	-	45.10	74.00	28.90
2242.50	38.60	V	Av	-1.40	-	37.20	54.00	16.80
4873.75	41.90	V	Pk	9.40	-	51.30	74.00	22.70
4873.75	37.00	V	Av	9.40	-	46.40	54.00	7.60

TEST DATA

Highest Channel

Frequency (MHz)	Reading (dB μ V)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	DCF (dB)***	Result (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1328.50	46.00	H	Pk	-4.00	-	42.00	74.00	32.00
1328.50	37.90	H	Av	-4.00	-	33.90	54.00	20.10
1495.50	46.90	H	Pk	-3.80	-	43.10	74.00	30.90
1495.50	38.40	H	Av	-3.80	-	34.60	54.00	19.40
1593.75	45.50	V	Pk	-3.40	-	42.10	74.00	31.90
1593.75	36.10	V	Av	-3.40	-	32.70	54.00	21.30
1661.75	45.00	V	Pk	-3.20	-	41.80	74.00	32.20
1661.75	36.00	V	Av	-3.20	-	32.80	54.00	21.20
2245.50	46.80	V	Pk	-1.40	-	45.40	74.00	28.60
2245.50	37.40	V	Av	-1.40	-	36.00	54.00	18.00
4923.75	41.20	V	Pk	9.60	-	50.80	74.00	23.20
4923.75	34.90	V	Av	9.60	-	44.50	54.00	9.50

Note(s):

- *Pol. H = Horizontal V = Vertical
- **AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.
- ***DCF (Duty Cycle Correction Factor) = $10 \log(1/x)$, $x = \text{On-time}/(\text{On-time} + \text{Off-time})$
- The radiated emissions testing were made by rotating EUT through three orthogonal axes and rotating the receive antenna with horizontal, Vertical polarization. The worst data was recorded.
- Peak emissions were measured using RBW = 1 MHz, VBW = 1 MHz, Detector = Peak
- For average measurements, "12.2.5.2 Average Power Measurement Procedures" at "558074 D01 DTS Meas Guidance v03r01" was used.
- The spectrum was measured from 9 kHz to 10th harmonic and the worst-case emissions were reported. No significant emissions were found beyond the 2nd harmonic for this device.

TEST DATA

802.11g mode

Lowest Channel

Frequency (MHz)	Reading (dB μ V)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	DCF (dB)***	Result (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1328.25	46.40	H	Pk	-4.00	-	42.40	74.00	31.60
1328.25	37.30	H	Av	-4.00	0.12	33.42	54.00	20.58
1498.00	47.40	H	Pk	-3.70	-	43.70	74.00	30.30
1498.00	38.90	H	Av	-3.70	0.12	35.32	54.00	18.68
1595.25	46.30	V	Pk	-3.40	-	42.90	74.00	31.10
1595.25	37.40	V	Av	-3.40	0.12	34.12	54.00	19.88
1662.00	46.40	V	Pk	-3.20	-	43.20	74.00	30.80
1662.00	36.90	V	Av	-3.20	0.12	33.82	54.00	20.18
2247.50	47.40	V	Pk	-1.40	-	46.00	74.00	28.00
2247.50	38.80	V	Av	-1.40	0.12	37.52	54.00	16.48
4828.13	51.80	V	Pk	9.20	-	61.00	74.00	13.00
4828.13	39.50	V	Av	9.20	0.12	48.82	54.00	5.18

Middle Channel

Frequency (MHz)	Reading (dB μ V)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	DCF (dB)***	Result (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1328.25	45.70	H	Pk	-4.00	-	41.70	74.00	32.30
1328.25	38.30	H	Av	-4.00	0.12	34.42	54.00	19.58
1498.00	47.00	V	Pk	-3.70	-	43.30	74.00	30.70
1498.00	38.90	V	Av	-3.70	0.12	35.32	54.00	18.68
1595.25	50.20	H	Pk	-3.40	-	46.80	74.00	27.20
1595.25	39.00	H	Av	-3.40	0.12	35.72	54.00	18.28
1662.00	46.60	V	Pk	-3.20	-	43.40	74.00	30.60
1662.00	37.00	V	Av	-3.20	0.12	33.92	54.00	20.08
2247.50	47.10	V	Pk	-1.40	-	45.70	74.00	28.30
2247.50	38.50	V	Av	-1.40	0.12	37.22	54.00	16.78
4828.13	48.10	V	Pk	9.20	-	57.30	74.00	16.70
4828.13	38.90	V	Av	9.20	0.12	48.22	54.00	5.78

TEST DATA

Highest Channel

Frequency (MHz)	Reading (dB μ V)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	DCF (dB)***	Result (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1331.75	46.70	H	Pk	-4.00	-	42.70	74.00	31.30
1331.75	37.30	H	Av	-4.00	0.12	33.42	54.00	20.58
1497.75	47.50	V	Pk	-3.70	-	43.80	74.00	30.20
1497.75	39.00	V	Av	-3.70	0.12	35.42	54.00	18.58
1594.75	45.10	V	Pk	-3.40	-	41.70	74.00	32.30
1594.75	36.30	V	Av	-3.40	0.12	33.02	54.00	20.98
1664.00	45.70	V	Pk	-3.20	-	42.50	74.00	31.50
1664.00	37.00	V	Av	-3.20	0.12	33.92	54.00	20.08
2243.75	47.10	V	Pk	-1.40	-	45.70	74.00	28.30
2243.75	38.00	V	Av	-1.40	0.12	36.72	54.00	17.28
4925.63	47.50	V	Pk	9.60	-	57.10	74.00	16.90
4925.63	37.70	V	Av	9.60	0.12	47.42	54.00	6.58

Note(s):

- *Pol. H = Horizontal V = Vertical
- **AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.
- ***DCF (Duty Cycle Correction Factor) = $10 \log(1/x)$, $x = \text{On-time}/(\text{On-time} + \text{Off-time})$
- The radiated emissions testing were made by rotating EUT through three orthogonal axes and rotating the receive antenna with horizontal, Vertical polarization. The worst data was recorded.
- Peak emissions were measured using RBW = 1 MHz, VBW = 1 MHz, Detector = Peak
- For average measurements, "12.2.5.2 Average Power Measurement Procedures" at "558074 D01 DTS Meas Guidance v03r01" was used.
- The spectrum was measured from 9 kHz to 10th harmonic and the worst-case emissions were reported. No significant emissions were found beyond the 2nd harmonic for this device.

TEST DATA

802.11n mode

Lowest Channel

Frequency (MHz)	Reading (dB μ V)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	DCF (dB)***	Result (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1327.75	46.30	H	Pk	-4.00	-	42.30	74.00	31.70
1327.75	37.70	H	Av	-4.00	0.13	33.83	54.00	20.17
1496.75	46.90	V	Pk	-3.70	-	43.20	74.00	30.80
1496.75	38.40	V	Av	-3.70	0.13	34.83	54.00	19.17
1593.50	45.30	V	Pk	-3.40	-	41.90	74.00	32.10
1593.50	36.20	V	Av	-3.40	0.13	32.93	54.00	21.07
1665.25	46.20	V	Pk	-3.20	-	43.00	74.00	31.00
1665.25	37.00	V	Av	-3.20	0.13	33.93	54.00	20.07
2244.50	47.30	V	Pk	-1.40	-	45.90	74.00	28.10
2244.50	38.20	V	Av	-1.40	0.13	36.93	54.00	17.07
4825.63	49.50	V	Pk	9.20	-	58.70	74.00	15.30
4825.63	40.00	V	Av	9.20	0.13	49.33	54.00	4.67

Middle Channel

Frequency (MHz)	Reading (dB μ V)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	DCF (dB)***	Result (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1497.00	47.60	V	Pk	-3.70	-	43.90	74.00	30.10
1497.00	38.50	V	Av	-3.70	0.13	34.93	54.00	19.07
1583.25	46.70	H	Pk	-3.50	-	43.20	74.00	30.80
1583.25	37.90	H	Av	-3.50	0.13	34.53	54.00	19.47
1660.75	46.70	V	Pk	-3.20	-	43.50	74.00	30.50
1660.75	36.70	V	Av	-3.20	0.13	33.63	54.00	20.37
1694.75	45.90	V	Pk	-3.10	-	42.80	74.00	31.20
1694.75	36.70	V	Av	-3.10	0.13	33.73	54.00	20.27
2246.25	46.60	V	Pk	-1.40	-	45.20	74.00	28.80
2246.25	37.40	V	Av	-1.40	0.13	36.13	54.00	17.87
4876.25	47.40	V	Pk	9.40	-	56.80	74.00	17.20
4876.25	39.20	V	Av	9.40	0.13	48.73	54.00	5.27

TEST DATA

Highest Channel

Frequency (MHz)	Reading (dB μ V)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	DCF (dB)***	Result (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1328.00	45.40	H	Pk	-4.00	-	41.40	74.00	32.60
1328.00	37.80	H	Av	-4.00	0.13	33.93	54.00	20.07
1498.50	46.70	H	Pk	-3.70	-	43.00	74.00	31.00
1498.50	10.70	H	Av	-3.70	0.13	7.13	54.00	46.87
1596.50	44.50	V	Pk	-3.40	-	41.10	74.00	32.90
1596.50	36.30	V	Av	-3.40	0.13	33.03	54.00	20.97
1662.25	45.80	V	Pk	-3.20	-	42.60	74.00	31.40
1662.25	36.70	V	Av	-3.20	0.13	33.63	54.00	20.37
2241.50	46.80	V	Pk	-1.50	-	45.30	74.00	28.70
2241.50	38.50	V	Av	-1.50	0.13	37.13	54.00	16.87
4926.25	45.20	V	Pk	9.60	-	54.80	74.00	19.20
4926.25	37.40	V	Av	9.60	0.13	47.13	54.00	6.87

Note(s):

- *Pol. H = Horizontal V = Vertical
- **AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.
- ***DCF (Duty Cycle Correction Factor) = $10 \log(1/x)$, $x = \text{On-time}/(\text{On-time} + \text{Off-time})$
- The radiated emissions testing were made by rotating EUT through three orthogonal axes and rotating the receive antenna with horizontal, Vertical polarization. The worst data was recorded.
- Peak emissions were measured using RBW = 1 MHz, VBW = 1 MHz, Detector = Peak
- For average measurements, "12.2.5.2 Average Power Measurement Procedures" at "558074 D01 DTS Meas Guidance v03r01" was used.
- The spectrum was measured from 9 kHz to 10th harmonic and the worst-case emissions were reported. No significant emissions were found beyond the 2nd harmonic for this device.

TEST DATA

8.9 Radiated Band Edge

FCC §15.247(d)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

802.11b mode

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	DCF (dB)***	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2389.92	46.20	Peak	H	-1.00	-	45.20	74.00	28.80
2390.00	32.27	Average	H	-1.00	-	31.27	54.00	22.73
2484.75	47.56	Peak	H	-0.50	-	47.06	74.00	26.94
2483.50	31.44	Average	H	-0.50	-	30.94	54.00	23.06

802.11g mode

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	DCF (dB)***	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2389.99	56.10	Peak	H	-1.00	-	55.10	74.00	18.90
2390.00	37.89	Average	H	-1.00	0.12	37.01	54.00	16.99
2483.50	63.29	Peak	H	-0.50	-	62.79	74.00	11.21
2483.50	44.57	Average	H	-0.50	0.12	44.19	54.00	9.81

802.11n mode

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	DCF (dB)***	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2388.12	57.45	Peak	H	-1.00	-	56.45	74.00	17.55
2390.00	38.41	Average	H	-1.00	0.13	37.54	54.00	16.46
2485.08	66.73	Peak	H	-0.50	-	66.23	74.00	7.77
2483.50	48.56	Average	H	-0.50	0.13	48.19	54.00	5.81

Note(s):

- *Pol. H = Horizontal V = Vertical
- **AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.
- Measurement of the radiated emissions is performed in vertical and horizontal polarizations. The worst data

were recorded

4. For peak measurements, the resolution bandwidth was set to 1 MHz and the video bandwidth was set to 3 MHz.
5. For average measurements, "12.2.5.1 Average Power Measurement Procedures" at "558074 D01 DTS Meas Guidance v03r01" was used.

9. TEST EQUIPMENT

No.	Instrument	Manufacturer	Model	Serial No.	Calibration Date	Calibration Interval
1	*Test Receiver	R & S	ESCS 30	833364/020	Jan. 09 2013	1 year
2	*Test Receiver	R & S	ESCS 30	100302	Oct. 08 2012	1 year
3	*Amplifier	R & S	SCU 01	10029	Apr. 05 2013	1 year
4	*Amplifier	Sonoma Instrument	310N	291916	Jul. 16 2013	1 year
5	*Amplifier	R & S	SCU18	10065	Apr. 05 2013	1 year
6	*Amplifier	R & S	SCU26	10011	Jul. 08 2013	1 year
7	Amplifier	R & S	SCU40	10008	Jul. 08 2013	1 year
8	*Pre Amplifier	HP	8449B	3008A00107	Jan. 09 2013	1 year
9	*Spectrum Analyzer	Agilent	E4440A	MY44303257	Jul. 16 2013	1 year
10	*Spectrum Analyzer	Agilent	E4440A	MY44022567	Apr. 05 2013	1 year
11	*Spectrum Analyzer	R & S	FSP40	100361	Jul. 16 2013	1 year
12	*Loop Antenna	R & S	HFH2-Z2	100279	Feb. 21 2012	2 year
13	Wideband Power Sensor	R & S	NRP-Z81	100634	Jul. 16 2013	1 year
14	*Biconical Log Antenna	ARA	LPB-2520/A	1180	Apr. 26 2012	2 year
15	*Horn Antenna	SCHWARZBECK	BBHA9120D	9120D-474	Aug. 13 2012	2 year
16	*Horn Antenna	Q-par Angus	QSH20S20	8179	Mar. 20 2013	2 year
17	Horn Antenna	Q-par Angus	QSH22K20	8180	Mar. 20 2013	2 year
18	Trilog-Broadband Antenna	SCHWARZBECK	VULB 9163	9163-454	Feb. 24 2012	2 year
19	*Trilog-Broadband Antenna	SCHWARZBECK	VULB 9168	9168-257	Mar. 06 2013	2 year
20	*LISN	R & S	ESH3-Z5	833874/006	Oct. 08 2012	1 year
21	*LISN	R & S	ESH2-Z5	100227	Apr. 04 2013	1 year
22	*Position Controller	DAEIL EMC	N/A	N/A	N/A	N/A
23	*Turn Table	DAEIL EMC	N/A	N/A	N/A	N/A
24	*Antenna Mast	DAEIL EMC	N/A	N/A	N/A	N/A
25	*Shielded Room	EM Eng.	N/A	N/A	N/A	N/A
26	*Position Controller	INNCO	CO2000	1480406/L	N/A	N/A
27	*Turn Table	INNCO	DS1200S	N/A	N/A	N/A
28	*Antenna Mast	INNCO	MA4000	N/A	N/A	N/A
29	*Anechoic Chamber	Seo-Young EMC	N/A	N/A	N/A	N/A
30	*Shielded Room	Seo-Young EMC	N/A	N/A	N/A	N/A

Note(s)

- * Test equipment used during the test.

10. ACCURACY OF MEASUREMENT

The Measurement Uncertainties stated were calculated in accordance with the requirements of measurement uncertainty contained in CISPR 16-4-2 with the confidence level of 95%

1. Conducted Uncertainty Calculation

Source of Uncertainty	X_i	Uncertainty of X_i		Coverage factor k	$u(X_i)$ (dB)	C_i	$C_i u(X_i)$ (dB)
		Value (dB)	Probability Distribution				
Receiver reading	RI	± 0.1	normal 1	1.000	0.1	1	0.1
Attenuation AMN-Receiver	LC	± 0.08	normal 2	2.000	0.04	1	0.04
AMN Voltage division factor	$LAMN$	± 0.8	normal 2	2.000	0.4	1	0.4
Sine wave voltage	$dVSW$	± 2.00	normal 2	2.000	1.00	1	1.00
Pulse amplitude response	$dVPA$	± 1.50	rectangular	1.732	0.87	1	0.87
Pulse repetition rate response	$dVPR$	± 1.50	rectangular	1.732	0.87	1	0.87
Noise floor proximity	$dVNF$	± 0.00	-	-	0.00	1	0.00
AMN Impedance	dZ	± 1.80	triangular	2.449	0.73	1	0.73
Ⓐ Mismatch	M	+ 0.70	U-Shaped	1.414	0.49	1	0.49
Ⓑ Mismatch	M	- 0.80	U-Shaped	1.414	- 0.56	1	- 0.56
Measurement System Repeatability	RS	0.05	normal 1	1.000	0.05	1	0.05
Remark	Ⓐ: AMN-Receiver Mismatch : + Ⓑ: AMN-Receiver Mismatch : -						
Combined Standard Uncertainty	Normal			± 1.88			
Expanded Uncertainty U	Normal ($k = 2$)			± 3.76			

2. Radiation Uncertainty Calculation

Source of Uncertainty	X_i	Uncertainty of X_i		Coverage factor k	$u(X_i)$ (dB)	C_i	$C_i u(X_i)$ (dB)
		Value (dB)	Probability Distribution				
Receiver reading	RI	± 0.10	normal 1	1.000	0.10	1	0.10
Sine wave voltage	dVsw	± 2.00	normal 2	2.000	1.00	1	1.00
Pulse amplitude response	dVpa	± 1.50	rectangular	1.732	0.87	1	0.87
Pulse repetition rate response	dVpr	± 1.50	rectangular	1.732	0.87	1	0.87
Noise floor proximity	dVnf	± 0.50	normal 2	2.000	0.25	1	0.25
Antenna Factor Calibration	AF	± 1.50	normal 2	2.000	0.75	1	0.75
Attenuation Antenna-receiver	CL	± 0.52	normal 2	2.000	0.26	1	0.26
Antenna Directivity	AD	± 1.00	rectangular	1.732	0.58	1	0.58
Antenna Factor Height Dependence	AH	± 0.50	rectangular	1.732	0.29	1	0.29
Antenna Phase Centre Variation	AP	± 0.30	rectangular	1.732	0.17	1	0.17
Antenna Factor Frequency Interpolation	AI	± 0.30	rectangular	1.732	0.17	1	0.17
Site Imperfections	SI	± 4.00	triangular	2.449	1.63	1	1.63
Measurement Distance Variation	DV	± 0.10	rectangular	1.732	0.06	1	0.06
Antenna Balance	Dbal	± 0.90	rectangular	1.732	0.52	1	0.52
Cross Polarisation	DCross	± 0.90	rectangular	1.732	0.52	1	0.52
Ⓐ Mismatch	M	+ 0.25	U-Shaped	1.414	0.18	1	0.18
Ⓑ Mismatch	M	- 0.26	U-Shaped	1.414	- 0.18	1	- 0.18
Ⓒ Mismatch	M	+ 0.98	U-Shaped	1.414	0.69	1	0.69
Ⓓ Mismatch	M	- 1.11	U-Shaped	1.414	- 0.79	1	- 0.79
Measurement System Repeatability	RS	0.09	normal 1	1.000	0.09	1	0.09
Remark	Ⓐ: Biconical Antenna-receiver Mismatch : + (< 200 MHz) Ⓑ: Biconical Antenna-receiver Mismatch : - (< 200 MHz) Ⓒ: Log Periodic Antenna-receiver Mismatch : + (≥ 200 MHz) Ⓓ: Log Periodic Antenna-receiver Mismatch : - (≥ 200 MHz)						
Combined Standard Uncertainty	Normal			± 2.63 (< 200 MHz) ± 2.74 (≥ 200 MHz)			
Expanded Uncertainty U	Normal ($k = 2$)			± 5.26 (< 200 MHz) ± 5.48 (≥ 200 MHz)			